Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

FOR ALL POWER ENGINEERS • STEAM, ELECTRICITY AND ALL OTHER POWER ENGINEERING SERVICES

CONTENTS

Technical Aid for Foreign Power Projects 64

Intercooling Supercharged Four-cycle Diesels 68

Maintenance Inspection and Testing of Large Rotating Machines 70
By John S. Johnson

Moist Combustion Air Lessens Fireside Deposits 73

The Steam Plant at the University of Idaho 74
By Henry F. Gauss

Models Cut Power Plant Design Costs 77

Small Power Plants, Too, Can Afford Good Instrumentation and Control 78
By P. S. Dickey

Is the Pressurized Boiler Furnace Here? 80

Diesels Behind Korea 84
By Dick LaCoste

Leak-Proof Heat Exchanger 102

Preferred Standards for 3600-rpm Turbine Generators Revised 104

Regular Departments

Notes on This Issue - 5 — Engineers' Preview - 7 — Helpful Bulletins - 45 New Equipment News - 52 — Power Plant Construction News - 60 — Letters to the Editors - 63 — New Engineering Books - 106 — News from the Field - 112

* * *

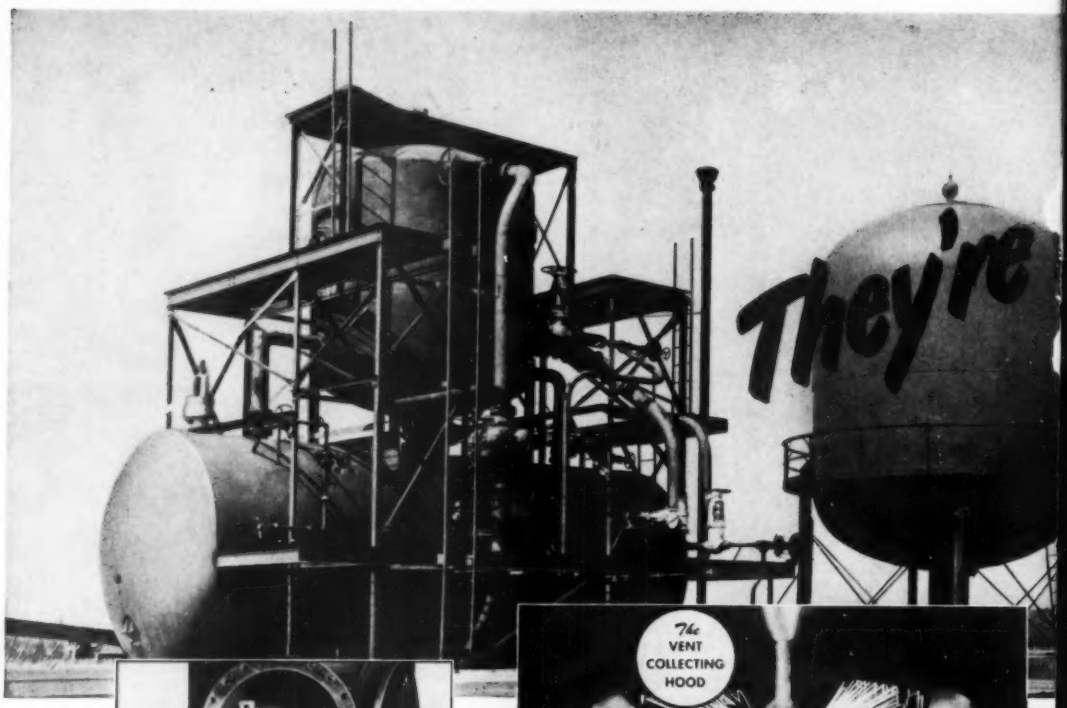
The PRACTICAL ENGINEER and ELECTRICIAN

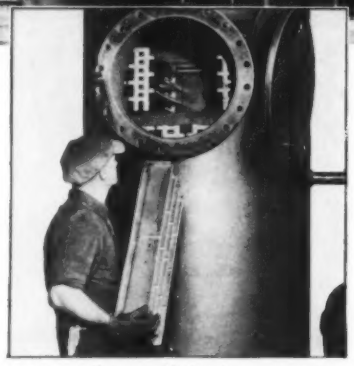
See Page 85 for Full Contents

Tricks in Dismantling Concrete Structures . . . Effects of Surface Film on Commutation . . . Basic Power Plant Figuring . . . Efficient Combustion of Natural Gas . . . Another Power Plant Laboratory . . . What Ailed the Engine? . . . Humidity Principles . . . Practical Hints and Kinks . . . Questions and Answers

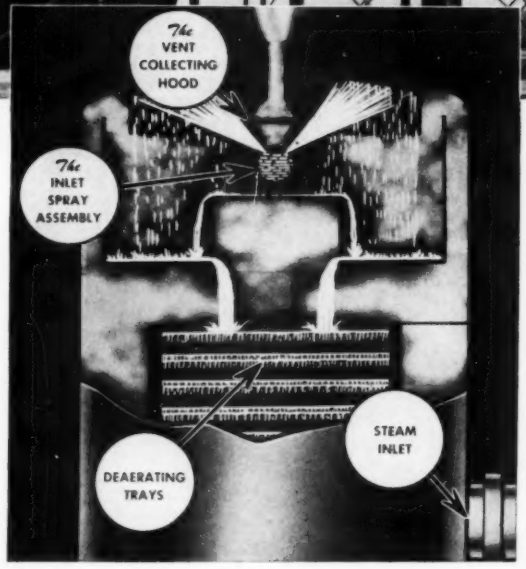
JUNE 1951

TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS





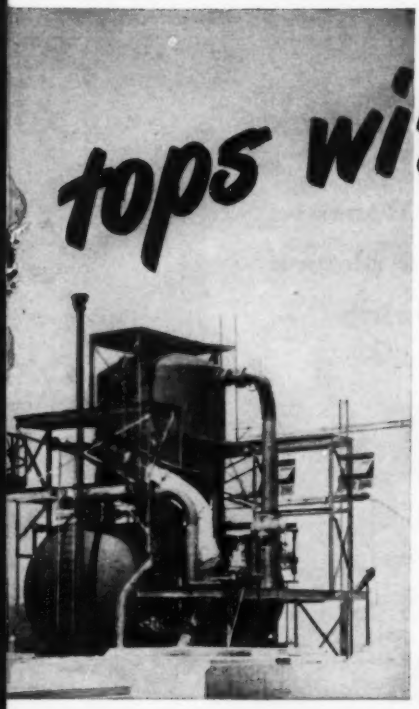
Stainless steel, spot welded, is the new tray material. It gives equal capacity at one-fourth the weight of cast iron. A tray assembly can be easily handled by one man without lifting equipment.



ELLIOTT COMPANY

Deaerator and Heater Dept.
JEANNETTE, PA.

tops with utilities!

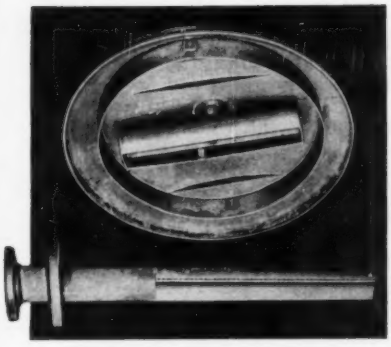


ELLIOTT
Deaerating Heaters

The distinguishing mark of any new important station is apt to be the newest type Elliott deaerating feedwater heater mounted upon its storage tank, silhouetted against the sky.

The installation at the left is typical—a fine new Southern Station with one 100,000 kwh unit already operating, a second similar unit under construction and two additional units planned. Two of the Elliott deaerating heaters, of 975,000 lb per hr, are already installed, and a third on order.

These new type Elliott deaerating heaters have design elements which eliminate a large percentage of the maintenance formerly necessary. The tubular vent condenser is replaced with an inlet spray unit and vent collecting hood which normally require no maintenance. Trays, formerly of heavy cast iron, are now of fabricated stainless steel—light and corrosion-proof. Non-corrodible materials are used everywhere undeaerated water contacts the metal. All in all, the new unit is characteristically Elliott in conception, in engineering excellence, in performance.



This is the unit that takes the place of the tubular vent condenser with its many small tubes, formerly mounted on top of the deaerating heater shell. The inlet spray unit and vent collecting hood are inside the shell, (see section drawing on the opposite page). Saves maintenance, saves headroom, makes a better installation.

The complete description of the Elliott deaerating heater will explain why it is favored by the largest utilities, as well as in smaller industrial plants. Write for Bulletin N-16.

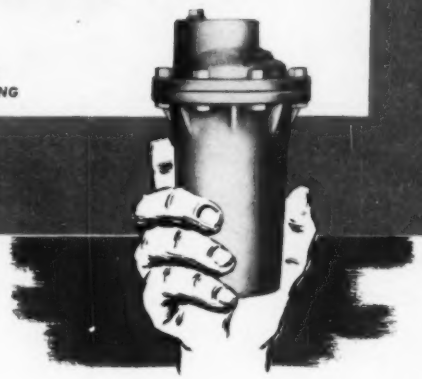
N-1001

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

HALF CENTURY OF 1901 ECo 1951 POWER PROGRESS

Only actual hot condensate capacities give a true picture of steam trap value

YOU KNOW THE CAPACITY WHEN YOU BUY AN ARMSTRONG



STEAM TRAP CAPACITY CHART
DIFFERENTIAL PRESSURE THROUGH TRAP, LBS. PER SQ. IN.
POUNDS OF CONDENSATE PER HOUR — ACTUAL CAPACITY OF TRAP, CONTINUOUS DISCHARGE

THEORETICAL calculations fail entirely to give a true picture of trap capacity. Orifice tests fail to account for capacity losses caused by pipe friction. Tests with cold or warm water do not take into consideration the capacity-reducing effect of flash steam. Only tests with actual trap hookups handling hot condensate will tell you the true continuous discharge capacity of a steam trap—and those are the capacities Armstrong gives you.

If capacities are misleading you may buy a trap too small for the job. Or, if you compare different makes of traps on a price basis you must know if they are comparable on a capacity basis or the comparison means nothing.

Dollar for dollar and size for size Armstrong steam traps give you greater capacity—another reason why they are your wisest buy. Your nearby Armstrong Representative can supply you. Call him for recommendations.

IT PAYS TO KNOW BEFORE YOU BUY!

THE ARMSTRONG STEAM TRAP CAPACITY CHART is based on hundreds of tests with hot condensate. You can depend on its accuracy.

SEE OUR CATALOG IN SWEETS OR CEC

ARMSTRONG MACHINE WORKS

810 Maple Street • Three Rivers, Michigan

The 36-PAGE STEAM TRAP BOOK gives Armstrong trap capacities and tells how to select the right size trap for every job. Ask for a copy.

ARMSTRONG STEAM TRAPS

EDITORIAL STAFF

ANDREW W. KRAMER
Editor

CHESTER R. EARLE
Managing Editor

THOMAS E. HANSON
Associate Editor

EARL R. NOREN
Assistant Editor

RALPH E. TURNER
Consulting Editor

RICHARD H. MORRIS
Contributing Editor

MARIAN E. HENIKEN
Equipment Editor

JAMES E. WILCOX
Staff Artist

SBME Society of Business Magazine Editors

TECHNICAL PUBLISHING CO.
110 S. DEARBORN ST.
CHICAGO 3, ILLINOIS

KINGSLEY L. RICE, *President*
EDWIN C. PROUTY, *Exec. Vice Pres.*
WALTER PAINTER, *Vice President*
EDWIN C. PROUTY, JR., *Secretary*
ARTHUR L. RICE, JR., *Treasurer*
RALPH E. TURNER, *Editorial Advisor*
JOHN O. AARVOLD, *Prod. Manager*

RICHARD M. WARD
Vice President in Charge of Sales

DISTRICT MANAGERS

CHICAGO: Arthur L. Rice, Jr.
John R. Morrison
110 S. Dearborn St., Chicago 3, Ill.
Phone: DE arborn 2-5446

NEW YORK: George L. Wright, Jr.
Oscar Wilds
1613 Graybar Bldg., New York 17, N. Y.
Phone: Murray Hill 5-3779

PHILADELPHIA: Oscar Wilds
1235 Jericho Road, Abington, Pa.
Phone: Ogontz 7261W

CLEVELAND: Richard M. Ward
2945 Fairmount Blvd.
Cleveland Heights, Ohio
Phone: Fairmount 1-0616

PACIFIC COAST: McDonald-Thompson
Roy M. McDonald, Mgr.
625 Market St.
San Francisco 5, Calif.
Phone: Yukon 6-0647

Edwin T. Thompson
3727 West Sixth Street
Los Angeles 5, Calif.

Harry Abney, Mgr.
Terminal Sales Bldg.
Seattle 1, Wash.
Phone: Main 3860

SOUTHWEST: McDonald-Thompson
Richard C. Wipperman
McDonald-Thompson
1118 Odeans Drive
Dallas 11, Texas
Phone: Winfield 4911

Subscription Information — Published Monthly. Prices: United States and Possessions one year $10.00, Canada one year $11.00. Other countries one year $12.00. Single copies $1.00. The Annual Index is furnished as a part of the December issue.

Contents of back issues of Power Plant Engineering and Power Generation will be found in both the Industrial Arts Index and the Engineering Index on file in Public Libraries.

Copyright, 1951 by Technical Publishing Co.

CCA

Acceptance under Section 34.64 P. L. & R., authorized by United States Post Office.

Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

Established 1896 as Practical Engineer. Title changed to POWER PLANT ENGINEERING in 1918, to POWER GENERATION in 1943; and to POWER ENGINEERING in May, 1950. Rights reserved to above titles.

June, 1951

VOLUME 55—NUMBER 6

Notes on This Issue

Power Plant Models

The model has become a very important and practical working tool in the design of power plants. Models made of wood, metal or plastics cost all the way from $300 to $4000 with a few elaborate ones as high as $50,000. This article shows how and why such expenditures can be justified in cutting the costs of designing and in avoiding expensive mistakes. It describes the Block Model, General Design Model, and Detailed Working Model, and their values in determining arrangement and appearance of plants; in spotting pipe interferences, accessibility and maintenance short-cuts.

The model, of course, does not replace drawings, many copies of which must be included with specifications, but photographs of the model are often useful in supplementing drawings and specifications.

One model maker with whom we talked says the cost of a model is saved several times over because of the errors in drawings which are brought to light in the process of building the model. He also says that a working model can clarify points difficult to show in a drawing.

Instrumentation in Small Power Plants

The purposes of good instruments and automatic controls are the same for small plants as for big ones; fuel and labor saving, safety and general reliability of operation. Mr. Dickey first discusses controls for a water heating boiler in his own plant, Bailey Meter Co. He then takes up in turn applications for package boilers, medium-sized industrial boilers, and small central stations, and discusses the present trends in centralization of controls.

Diesels Behind Korea

A picture story describing how two Japanese made diesel engines help to guide our pilots over the Arctic Circle route to Japan.

The Pressurized Boiler Furnace

Power engineers have known for many years that heat transfer from hot combustion gases in a furnace to the water in the boiler tubes is much faster if the velocities of the gases outside the tube and the water inside the tube are increased. In a pressurized boiler, the velocity of combustion gases is increased by means of a forced draft fan at high enough pressure to force all gases completely through the boiler and out the stack.

In Europe the Velox boiler which uses both forced water circulation and pressurized furnace has been used successfully for some time to take advantage of this principle, but the Velox boiler has never been adopted in this country.

However, during the past 4 or 5 years the pressurized boiler furnace has reached the stages of practical application here and today we have a large number in operation. Developments include gas and oil fired boilers as well as coal and this article reviewing the subject is of practical and timely value to everyone interested in boiler operation.

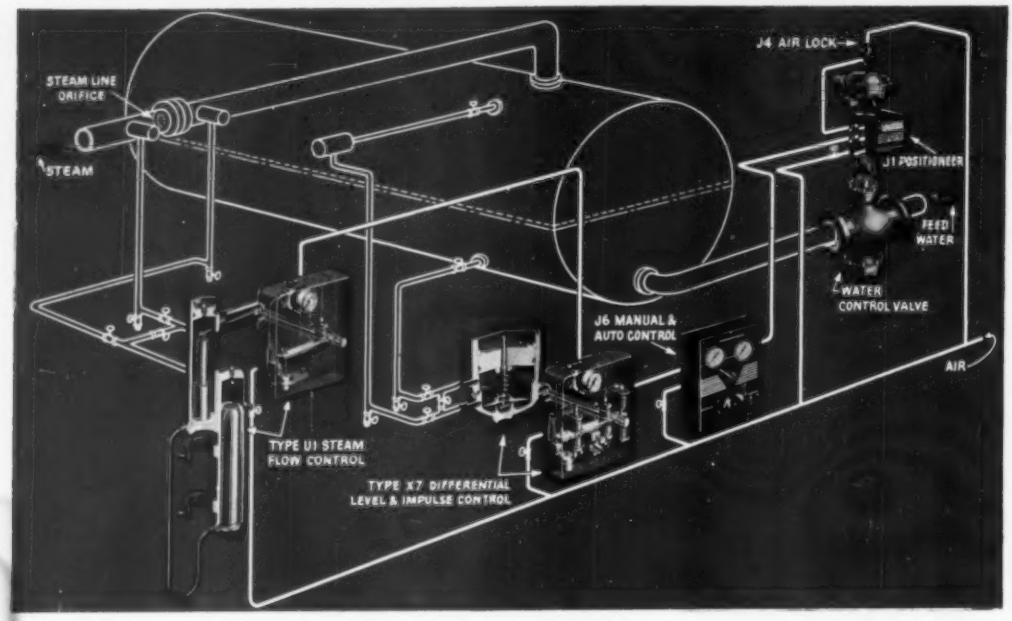
Intercooling

While superchargers enable stationary Diesel engines to develop more power by forcing more air into the cylinders, they also tend to increase the air temperature which reduces the developed horsepower. The intercooler cools the air after it comes from the supercharger but before it enters the intake manifold. This article discusses the merits of intercoolers and gives examples showing how their application has greatly increased the efficiency of existing diesel engines.

U. of Idaho's Steam Plant Extension

Professor Gauss tells us about the developments in this small plant at the University of Idaho over a 25 year period and in particular about a recent replacement of two old HRT boilers with a spreader stoker fired boiler, 40,000 lb per hr, which can burn the wide variety of coals available in the region.

Swartwout Impulse Regulation assures correct feed water supply under any load condition



SWARTWOUT two-element controls—by utilizing the very forces that cause false drum level—produce a corrective impulse that assures correct level even under rapid load swings. Since "shrink" and "swell" are functions of *rate of change*, as well as magnitude of load, only Impulse Regulation gives satisfactory operation under *any rate of change in load of any magnitude.*

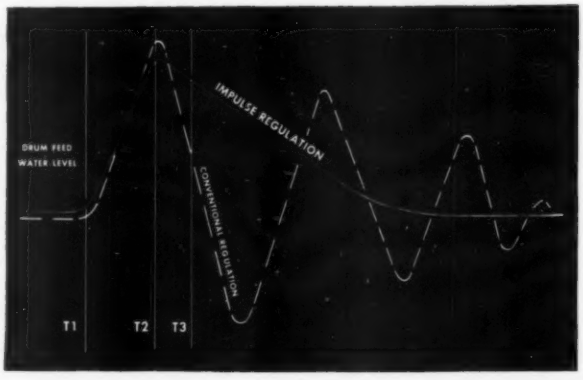
Type U1 flow transmitter takes square root of steam line orifice differential and feeds airloading pressure, which is directly proportional to steam flow at all flows, to X7 differential level and impulse control. X7 unit positions flow valve by sending airloading pressure which is result of combining *rate of change* of steam flow function with water level.

Graph *(right)* shows how proper combination of these forces, plus reset and setback features, assures that valve will give desired operation under *any* load condition. System can be adjusted to maintain drum level constant at all loads, carry it high at high loads, low at low loads, or vice versa. In addition to this FW6 two-element system, Swartwout also makes an FW7 three-element impulse regulating system. Other types include FW5 single-element system and SC (FW1) thermo-hydraulic system.

A-5750

Swartwout

POWER PLANT EQUIPMENT



SEND FOR BULLETINS S-27, S-20-E • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

ENGINEERS' PREVIEW

IF YOU'RE a man of distinction, the location of your home town might have been a factor.

Dr. Stephen S. Visher, University of Indiana, in a study of men listed in Indiana's "Who's Who," showed more came from certain sections of the state than from others, according to the Chicago *Daily News*.

In a report to the Association of American Geographers, Prof. Fisher said he found:

—More leaders came from towns than from farms, from small cities than from large.

—The warm southwestern part of the state produced fewer notables than the cooler northern part.

—The wealthiest areas are not the most productive of notables.

—Relative hilly country was more productive than level areas.

—Families of professional men produce twice as many distinguished offspring as families of businessmen, 20 times as many as farmers, 45 times as many as skilled laborers.

★ ★ ★

NEW TIN-CONSERVING solders are basically silver-tin-lead alloys compared with the usual tin-lead variety. These are designed to permit savings of 50 per cent or more in tin normally used for solders. Addition of small percentage of silver permits marked reduction in tin content, at same time giving joint at least as good as original alloy. This solder group is outgrowth of similar series of solders developed and produced by Federated Metals Division of American Smelting and Refining Co. during World War II. Showed that industrial soldering could be continued without fear of failure through use of these lower-tin solders.

★ ★ ★

INDIVIDUAL businesses should do neither too much nor too little planning for an atomic attack, the Research Institute of America has advised its members in a 25-page memorandum entitled "Your Business and the A-Bomb," pointing out that the company's time and the defense effort can both be better served by concentrating on business instead of over-elaborate preparation. The Research Institute warns that at the same time too little planning can also be fatal. For example, even though its physical location may be many miles from the scene of a blast, an industry may be very vulnerable if it depends on a single railroad or a single source of power that may become an enemy target. Companies outside danger zones will be vitally affected by Washington action, if their suppliers or customers may be hit and thereby relieved of legal obligation. These and other problems are discussed in the memorandum, copies of which may be obtained from the Research Institute of America, 292 Madison Avenue, New York 17, N. Y.

★ ★ ★

ENTIRELY NEW concept of lubrication involving air bearings or air jet lubrication, now being investigated, according to *The Ohmite News*. Film of air acting as lubricant is only 0.001 inch thick, fed into bearing races through small tubes 0.003 inch diameter. Spindle speeds of 150,000 rpm claimed. With sliding members, 7½-ton block of steel, supported by air film, can be easily moved.

THIS WILL probably cause "the war between the states" to break out again. But everybody in this part of the country is exclaiming "Well, at last!—they've found some use for okra!" It's been found a substitute for blood plasma formerly made only from human blood. Discovery made by Dr. K. Ihrig, vice president in charge of research at Allis-Chalmers, Dr. Hiram B. Benjamin, Dr. Donald Roth and Dr. Walter Zeit, the three latter members of Marquette University medical school staff. Tests to date on animals show that okra substitute has same beneficial effect as blood plasma—in some ways better because it does not carry harmful virus as some plasma does—stable, can be stored a long time without refrigeration. Discovery comes at a time when civilian defense authorities have big problem in securing enough blood plasma in case of a disaster in one of our American cities.

★ ★ ★

IF ONE-SOCK MURPHY, meanest fireman in the Gas Works, had been able to get one of the new honey refractometers, he wouldn't have got himself and John Raven, the Gas Works' chief operating engineer, into the stew that John narrated on page 84 of our April issue. You remember that One-Sock Murphy had equipped his boiler house with several hives of bees and furthermore, was operating the boilers so they would make a lot of smoke, in order to give the honey a good Scotch flavor—so he thought. Result:—he was making a public nuisance of the Gas Works and the Local Association for Civic Improvement called on the boss and threatened to take out an injunction against them for polluting the atmosphere.

However, one of the male members of the Association happened to know a lot about bees and, as a result, convinced One-Sock of the error of his ways. Perhaps if One-Sock had possessed one of the new hand-sized honey refractometers to determine in a few seconds the moisture content of honey, he might have really put the bee on the bees. With this device, developed by Bausch & Lomb, only a few drops of a honey sample are required and direct readings to one-tenth of one per cent moisture can be obtained, eliminating the need of referring to tables used by most apiarists (translation—bee raisers). Perhaps a little analysis of the moisture or of the honey would have shown One-Sock that he was just imagining the smoke gave it a good Scotch flavor. Of course, after the city improvement guy, who knew all about bees, got through with One-Sock, he didn't need the refractometer anyway but it might have made a different story.

★ ★ ★

FOR FIRST TIME in any ASTM specification, sampling procedure based on statistical analysis and quality control may be included. At recent series of meetings on Wires for Electrical Conductors, Committee B-1 agreed to submit to letter ballot revision of the Standard Specifications for Hard-Drawn Copper Wire (B1-49) including these provisions. Work authorized along similar lines on Standard Specifications for Soft or Annealed Copper Wire (B3-45). Chairman of Committee B-1 is D. Halloran, Consolidated Edison Co. of New York, 4 Irving Place, New York City, or full information from American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

NEW HIGH-CONDUCTIVITY CONCRETE may reduce costs and expand applications for radiant heating. Invention comprises formula of special aggregates blended and added to concrete and other plastic masses. Blended aggregates greatly increase heat conductivity, also wearing qualities of concrete. Higher heat-conductivity of new concrete means saving in pipe for radiant heating from 25 to 30 per cent per installation, compared with quantity of pipe required with standard concrete, while cost of product will be only about 10 per cent of total savings achieved. Basic products commercially available, although never previously applied to this purpose. Will be supplied by a Pittsburgh area firm; and developer of idea, Products Planning Co., will license manufacture of finished product.

★ ★ ★

FEEDBACK control systems and broad concepts of system engineering will be subject of special course during summer session 1951 at Massachusetts Institute of Technology, August 30 to 31. Plans for ten-day course announced by Professor Donald P. Campbell of MIT Department of Electrical Engineering. Will include survey of theory of feedback systems with emphasis on dynamic operations and system synthesis. Industrial applications of feedback control systems, or servomechanisms, in fields such as steel making, printing, petroleum processing, wood working, textile manufacturing, chemical processing and power distribution will be discussed. Courses intended for engineers with background and problems of industrial engineering and production management. Will be open to those who have had no previous acquaintance with servomechanism field, though familiarity with engineering problems will be helpful. Full information about course and living accommodations may be obtained from Professor Walter H. Gale, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass.

★ ★ ★

LIQUID OZONE, beautiful dark blue substance, can now be handled safely as result of research at Armour Research Foundation of Illinois Institute of Technology. Successful taming of concentrated liquid ozone develops a rocket fuel, but it has other valuable military and commercial applications. Can be decomposed directly to oxygen for submarine uses and high high altitude flying, is ideal agent for water purification, air purification and bleaching.

★ ★ ★

JULIAN E. TOBEY, President, Appalachian Coals, Inc., and Chairman of the BCR Technical Advisory Board, has been honored with the 1950 Percy Nicholls Award for notable scientific or industrial achievement in the field of solid fuel. The award was presented to Mr. Tobey at the 13th Annual Joint Meeting of the AIM and ME and the ASME at Cleveland. The citation was presented to Mr. Tobey by E. G. Bailey, who pointed out that Mr. Tobey has been an outstanding leader in the coal industry, making important contributions to the design of coal burning equipment to use a wider range of coal and organizing comprehensive fuel engineering conferences that led to greater coordination of the common interests of coal producers, consumers and equipment manufacturers. Mr. Tobey joined the staff of ACI in 1934, became vice president in charge of engineering in 1940. In 1942 he established and set up the Fairmont Coal Bureau, which he served as director until he returned to ACI as president in 1948.

MONSANTO Chemical Co. has informed Atomic Energy Commission it is ready to study feasibility of developing and operating nuclear reactors for production of plutonium and with ultimate goal of producing electric power.

Commission has suggested to Monsanto conditions under which it would be willing to go forward with first step of plan, which was originally proposed by Dr. Charles Allen Thomas, Monsanto executive vice president, in a speech at Hobart College, and subsequently developed in detail with Commission.

Dr. Thomas said Monsanto is ready to study basic data, with following objectives:

a. Determine if sufficient materials and information exist to permit the design and construction of a nuclear reactor producing power and plutonium.
b. Determine if such a reactor could make plutonium at a cost equal to or less than present costs and at the same time produce power at an economic cost, after application of credits for the plutonium produced.
c. Recommend any additional research and development work required for the design of a power reactor.
d. Set up the basic design premises for a power reactor producing plutonium.

Cost of this survey would be defrayed by Monsanto and any collaborators. Study based upon understanding that Commission would make available information pertaining to power reactors, reasonable consultation by Commission personnel.

★ ★ ★

NEW MICROWAVE RELAY system featuring some of longest links between terminals ever used being installed between Fruitland, N. M. and a point in Arizona near California border. Using microwave links averaging 50 miles between mountain top sites, this is 500-mile Philco communications system being installed for El Paso Natural Gas Co. Can handle 24 simultaneous telephone conversations or several hundred teletype or telemeter channels. Initial installation cost estimated at $500 to $700 per mile, while pole-and-wire line costs might be prohibitive over difficult terrain.

In installing pipeline and accompanying microwave communications, El Paso Natural Gas Co. is co-operating with archaeologists of National Park Service. Lines run across area rich in archaeological relics of early American civilization. Scientists of National Park Service in charge of excavation of all archaeological remnants discovered during the construction.

★ ★ ★

FIRST of a new group of alloy steels to be known as T-steels. "Carilloy" T1 is a multiple-alloy plate steel, which combines extremely high strength with excellent ductility and toughness, even at sub-zero temperatures, as announced by Carnegie-Illinois Steel Corp.

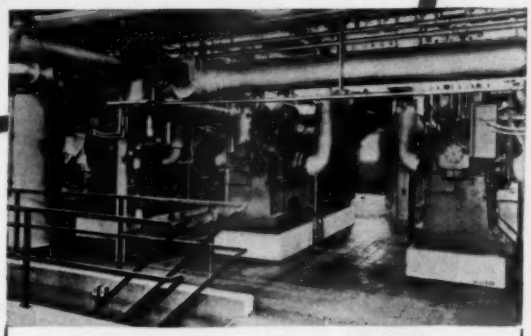
With almost double the strength of high-strength, low-alloy steels and almost triple that of ordinary welding grade structural steels, "Carilloy" T1 promises to effect considerable savings in applications calling for heavy steel members of ½ inch thickness and up. It is designed to be at least two to three times as resistant to atmospheric corrosion as plain carbon steels.

This plate steel is furnished heat treated to a minimum yield strength of 100,000 psi. It maintains adequate toughness even at this high level of strength and is suitable for application where extreme high strength and good weldability are required.

Welding does not adversely affect the properties of this steel, which has been designed to require no special preheating or postheating treatments in welding or gas-cutting operations beyond those normally used with ordinary structural steels.

What Metals Are Best For Centrifugal Boiler Feed Pumps?

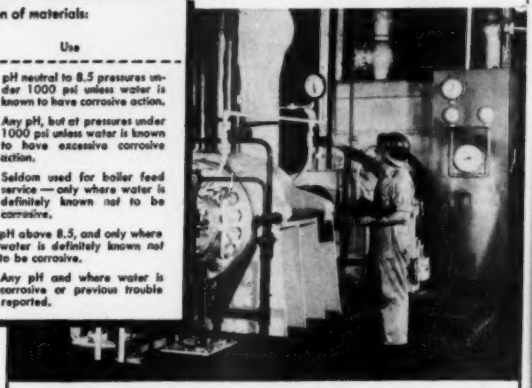
Drawing on their long experience in the field of hydraulics, Worthington engineers produce boiler feed pumps that are metallurgically correct in design, meeting every requirement as to temperature, pressure and corrosion-erosion resistance. As a result, Worthington boiler feed pumps perform better and last longer.



Three Worthington Axially Split Centrifugal Boiler Feed Pumps At The Kansas Power And Light Company Plant, Hutchinson, Kansas.

The following table represents Worthington's recommendation of materials:

Casing	Fittings	Maximum Temperature	Use
1. Cast Iron	Bronze	250 F	pH neutral to 8.5 pressures under 1000 psi unless water is known to have corrosive action.
2. Cast Iron	13% Chromium Stainless Steel	350 F	Any pH, but at pressures under 1000 psi unless water is known to have excessive corrosive action.
3. Carbon Steel	Bronze	250 F	Seldom used for boiler feed service — only where water is definitely known *not* to be corrosive.
4. Carbon Steel	13% Chromium Stainless Steel	400 F	pH above 8.5, and only where water is definitely known *not* to be corrosive.
5. 5% or higher Chromium Steel	13% Chromium Stainless Steel	Any temperature normally encountered	Any pH and where water is corrosive or previous trouble reported.



One of Several Solid Barrel, Radially Split, High Pressure Boiler Feed Pumps at the Trenton Channel Station of the Detroit Edison Co.

This proven selection of materials coupled with the most advanced design, superior workmanship and a thorough knowledge of application show why . . .

THERE'S A *RIGHT* WORTHINGTON PUMP FOR YOU

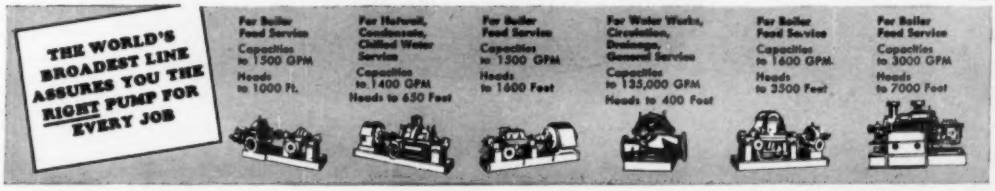
. . . *right* for the pressure and temperature of your boiler feed service . . . *right* for maximum economy and dependability. For further proof that *there's more worth in Worthington*, contact our nearest District Office, or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

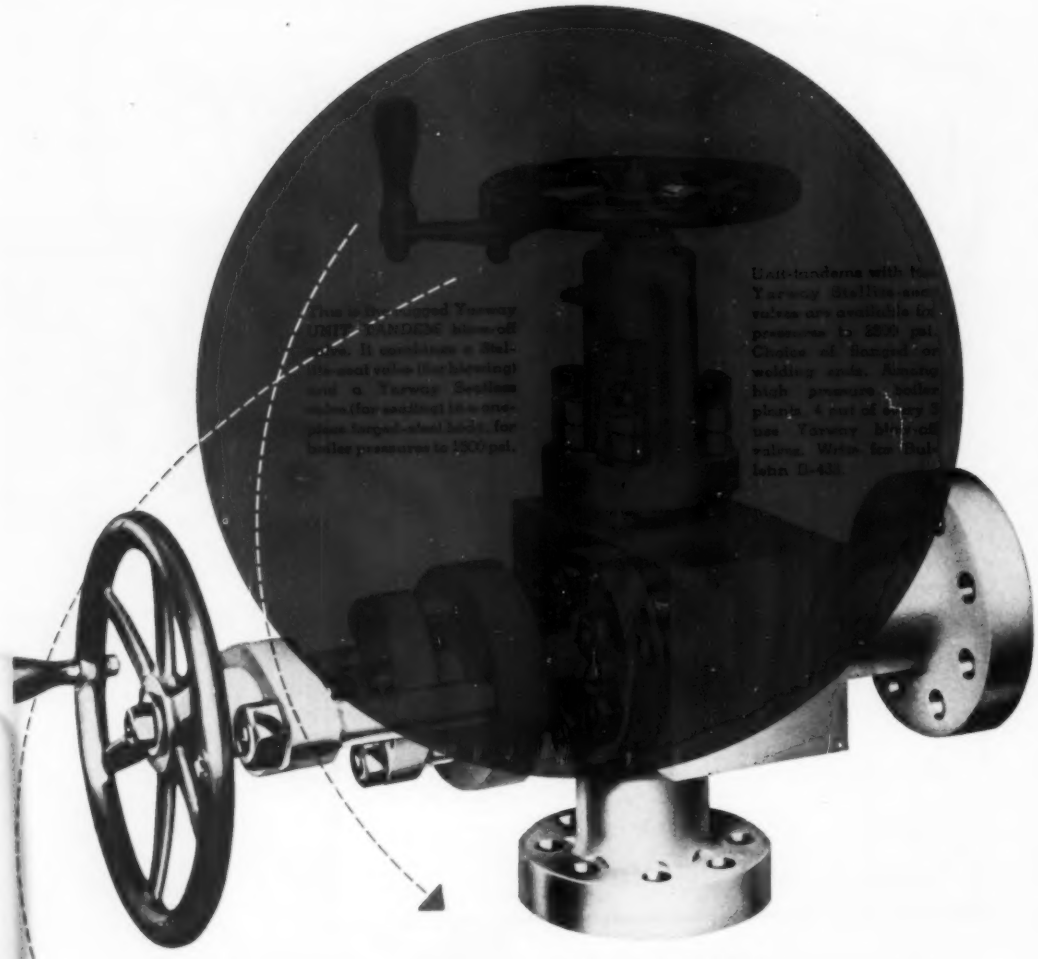
MEMBER

WORTHINGTON

C1.2

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB


For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Hotwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1300 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3300 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet

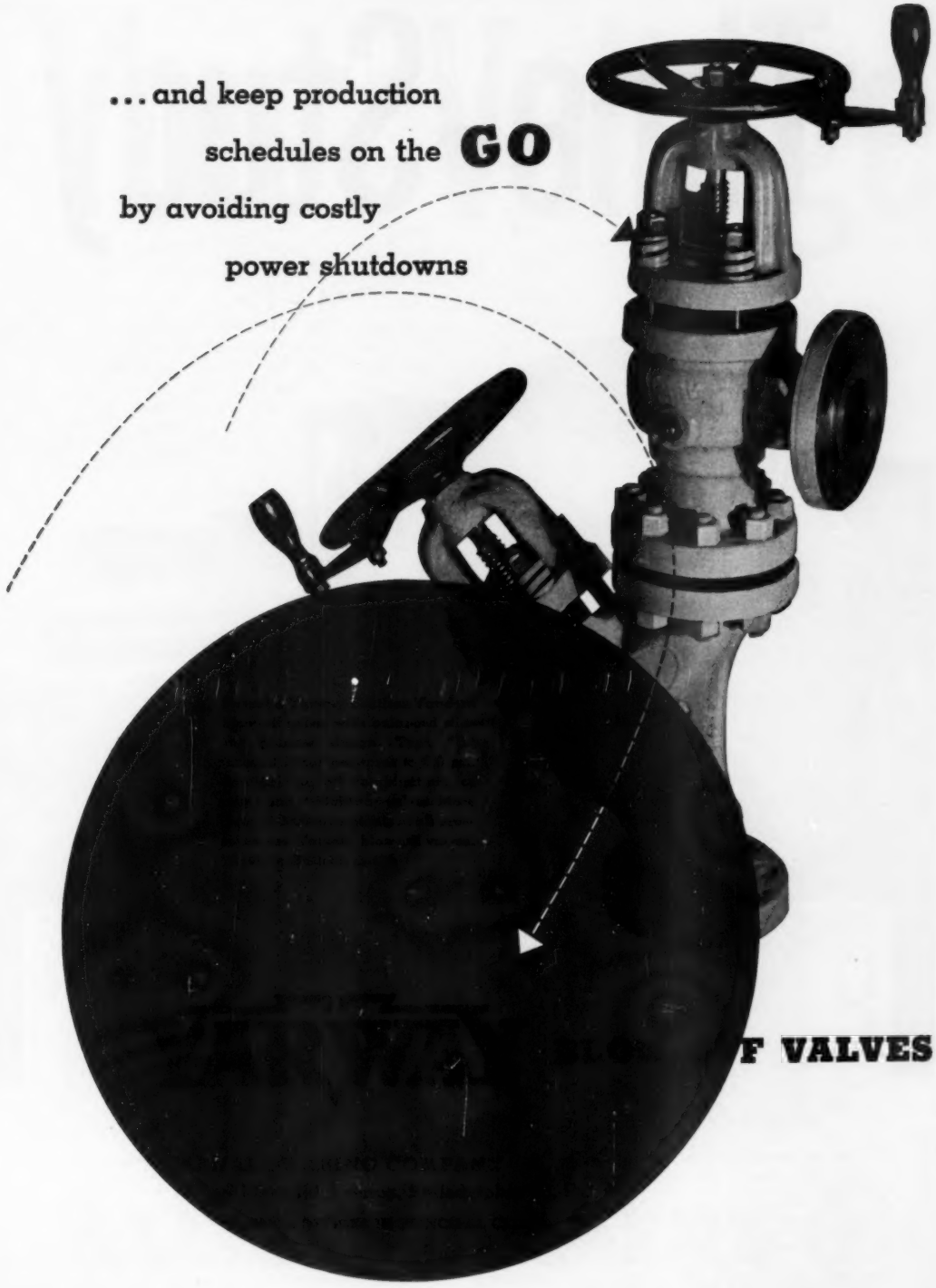


Dependable Yarway Blow-Off Valves

STOP a lot of

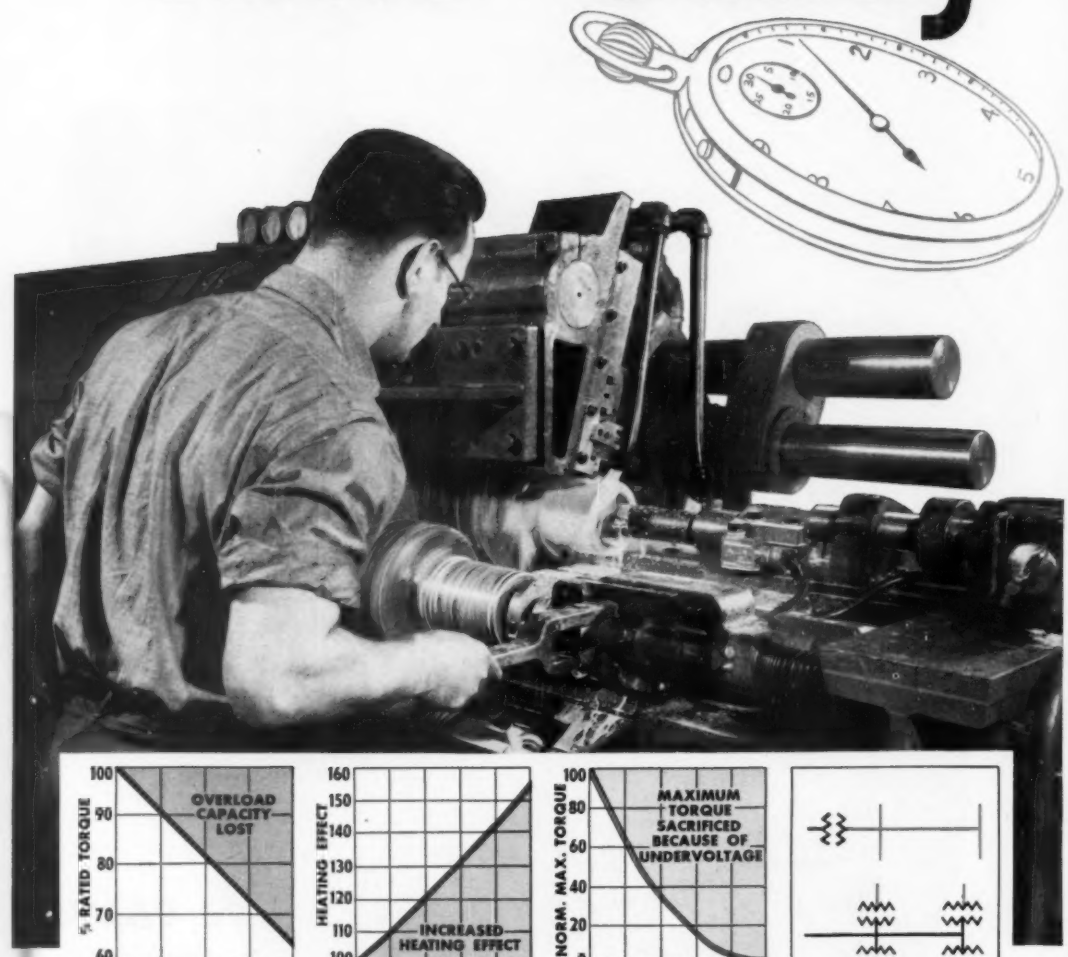
boiler blow-down troubles . . .

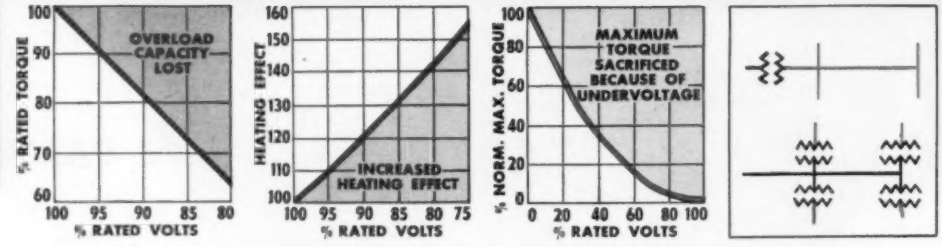
...and keep production schedules on the **GO** by avoiding costly power shutdowns



F VALVES

Time-Study





FULL PRODUCTION demands that rated voltage be maintained to all motors. Overload capacity, that extra push necessary for short intervals on many processes, falls off rapidly on undervoltage . . . falls approximately 10% for every 5% drop below rated voltage.

MOTORS BURN OUT quicker at undervoltage because of increased heating effect. Overload relays in the controls protecting your motors trip because of the extra current through them, open circuits to motors — cause machine down-time and production loss.

JOBS TAKE LONGER because torque and horsepower drop when voltage drops. Less torque means lighter cuts on lathes, shapers and other machine tools. More time must be spent to get the same job done. More overhead, more manhours must be figured into every job.

A MAJOR CAUSE of undervoltage is voltage drop in secondary feeders. Existing systems may not be adequate for new production schedules. Install A-C Substations at load centers to reduce line losses, cut feeder length, hold proper voltage, increase production.

Your Voltage

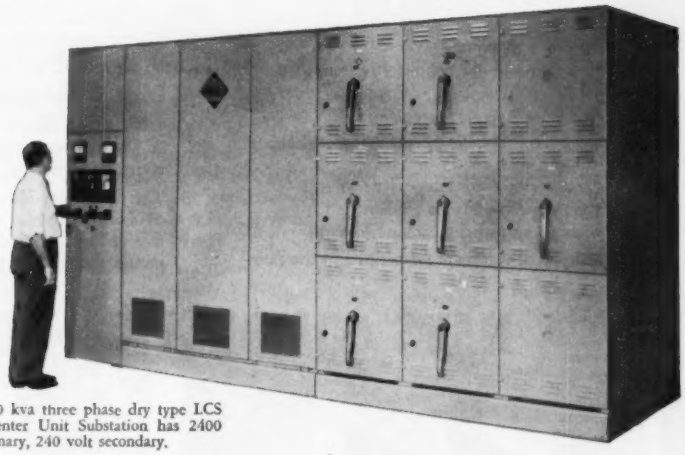
STOP WASTING MANHOURS on slow producing machines. Get the most from the production equipment in your plant by installing unit substations to correct undervoltage. No electrical equipment gives top performance *unless* it operates at rated voltage . . . and even well designed distribution systems may prove inadequate because of today's added loads and increased production schedules.

For example, if your squirrel-cage motors operate at 10% undervoltage, maximum torque available to start machinery is reduced 19% . . . heating effect within the motors is inceased 21% . . . overload capacity falls, efficiency drops.

Increase your output by eliminating production slow-downs resulting from overloaded motors . . . machine down-time due to tripped starters or circuit breakers. Install Allis-Chalmers LCS Unit Substations at load centers and eliminate excessive line drop by shortening low voltage cables. Allis-Chalmers LCS Load Center Unit Substations are neat, compact, easy to install, and provide protection to personnel.

You can count on the cooperation of experienced Allis-Chalmers substation engineers in working out your distribution system. Get in touch with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for bulletins 11B6285A, 11B6325B and 11B6895. A-3371

LCS Unit Substation



This 750 kva three phase dry type LCS Load Center Unit Substation has 2400 volt primary, 240 volt secondary.

ALLIS-CHALMERS

what *results* do you want from your **COMBUSTION CONTROL SYSTEM ?**

Of course you want the best results you can get. But, more particularly, you want *specific results to solve your combustion problems.*

Hays engineers "focus" on your problems. They have the experience in planning combustion control systems to give you specific results like:

- smoke abatement
- reduced boiler room labor costs
- decreased outage
- constant steam pressure
- lower fuel bills by means of switching fuels
- increased boiler capacity
- firing mixed fuels efficiently
- rapid response to steam demand

Such specific results are described in the published "Case Histories" listed at the right. Here's how you can get them—

HOW TO GET RESULTS

Send a brief statement of your combustion problem and the results you want to Orval W. Riggs, Manager, Application Engineering, The Hays Corporation, Michigan City (3), Indiana. In return, you will receive:

1. Our preliminary recommendations for a solution to *your* problem.
2. A 48-page booklet on the various Hays control systems and how they work.
3. The five "Case Histories" giving details of Hays control, "getting results" on five different problems at leading companies throughout the country.

HAYS COMBUSTION CONTROL

Low maintenance?

"we find that due to the (Hays) properly controlled combustion, our maintenance on both stokers and boilers has been considerably decreased."

American Tobacco Company
Bulletin—AT

Good CO_2?

"CO_2 readings show that on an average day our CO_2 varies between 13% and 14% despite load fluctuations."

Sunshine Biscuits, Inc.
Bulletin—SB

Increased efficiency?

"Operating efficiency has been as high as 82%—much of the credit going to the accuracy of (Hays) automatically controlled combustion."

Sherwin Williams, Chicago Plant
Bulletin—SW

Fuel savings?

"we estimated that...we would be able to pay for the new equipment (Hays Combustion Control) out of fuel savings in three years. Since then, the records show that the amortization of the original investment has been accelerated."

Raybestos—Manhattan, Inc.
Bulletin—RM

Rapid response to wide load swings?

"we have made test runs using the Hays system, bringing the load rapidly up from 8,000 to 80,000 lbs per hour with excellent results. Fuel-air ratio was held at the desired value and CO_2 at 15%."

Bemis Brothers Bag Company
Bulletin—BB

Bulletin—AT

Bulletin—SB

Bulletin—SW

Bulletin—RM

Bulletin—BB

THE **HAYS** CORPORATION *MICHIGAN CITY 7, INDIANA* • Automatic Combustion Control

Boiler Panels • Hays-Penn Flowmeters • Variflow Meters and Veritrol • Gas Analyzers • Draft Gages • Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

AT ROCKFORD

CENTRAL ILLINOIS ELECTRIC AND GAS CO.
Rockford, Illinois

It's Detroit Rotograte

Detroit RotoGrate Stoker ready for shipment to Sabrooke Station.

FOUR CONTRACTS FOR TWO STATIONS

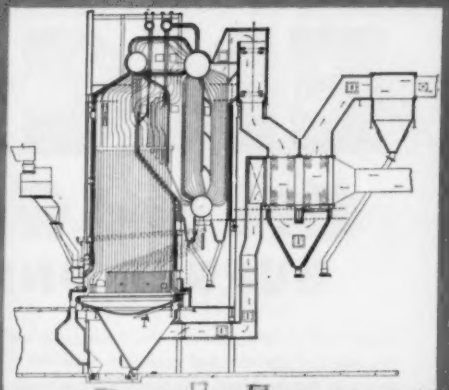
Stone & Webster Engineering Corporation
Engineers and Constructors

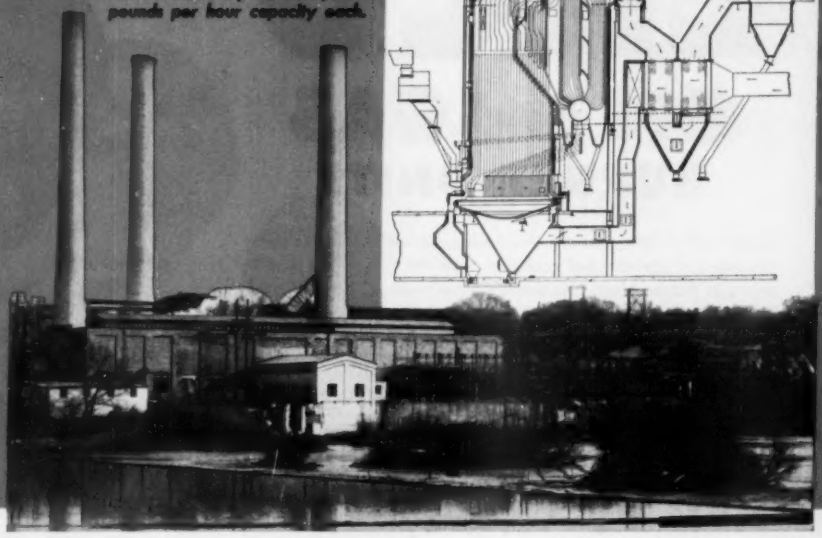
960,000 Pounds of Steam per Hour total Capacity

Write for complete information on Detroit RotoGrate Stokers.

EXTENDING FORDAM STATION

This side elevation of stoker and generator with economizer and air heater is typical of the Fordam and Sabrooke Station installations which have up to 300,000 pounds per hour capacity each.





Fordam Station Rockford, Illinois

Detroit RotoGrate Stokers were selected for the new boilers in the Fordam and Sabrooke Stations at Rockford:

FIRST because they efficiently burn any type of bituminous coal. SECOND because of the lower investment necessary in equipment, foundations and building. THIRD because of lower power consumption to operate both stokers and auxiliaries and lower maintenance with a minimum of slagging difficulties in the furnace.

RotoGrate Stokers are modern spreader stokers with grates that move slowly forward, discharging the ash at the front. They permit high burning rates to produce more capacity per foot of furnace width.

At Rockford, as well as hundreds of other plants, they are operating at highest efficiency—with greatest satisfaction.

Interior of Sabrooke Station shows number one unit.

NEW SABROOKE STATION

Sabrooke Station— Rockford, Illinois

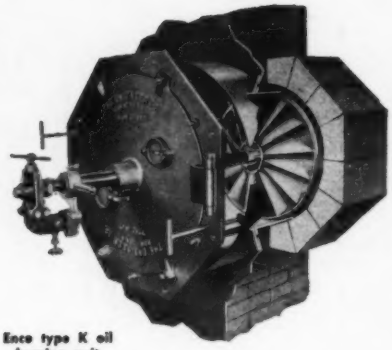
DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

General Motors Building—Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan

ENCO
OIL and GAS
BURNER UNITS



Enco type K oil burning unit

High load or low, you can count on completely uniform combustion and greater fuel economy with the Enco Type K Oil and Gas Burner Unit. It is flexible three ways . . . (1) designed for use with either oil or gas—or both, (2) flexible where steam demands swing sharply and (3) can be operated by either natural or forced draft.

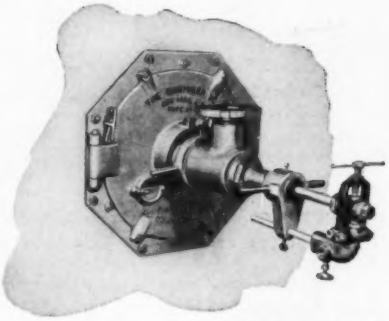
ENCO BURNER UNITS ARE MADE in many sizes to suit all capacity requirements.

Enco Interchangeable Atomizers

Wide Range Mechanical—Capacity range of 10 to 1. Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

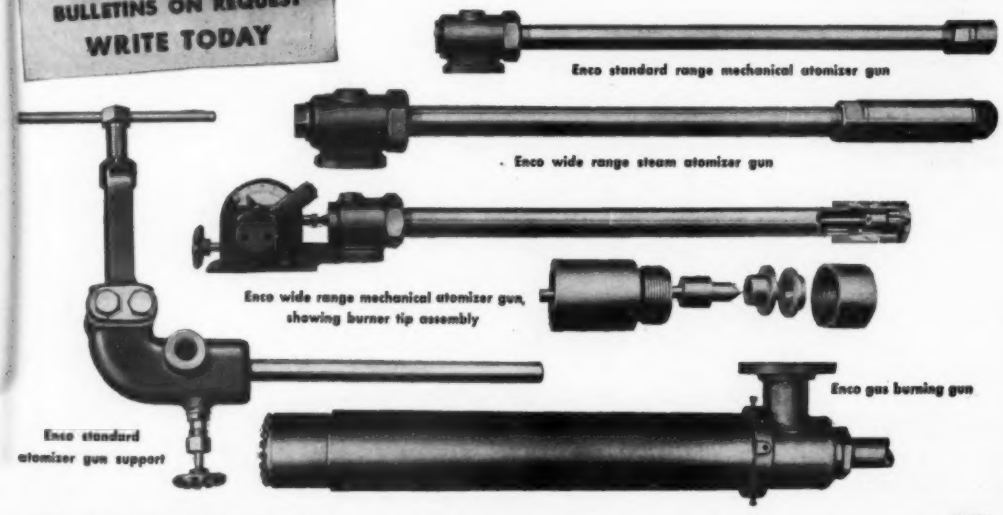
Steam or Air—Capacity range of 10 to 1. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical—Available in all sizes to suit load and capacity requirements.



Enco type K gas-oil burning unit

BULLETINS ON REQUEST
WRITE TODAY



Enco standard range mechanical atomizer gun

Enco wide range steam atomizer gun

Enco wide range mechanical atomizer gun, showing burner tip assembly

Enco gas burning gun

Enco standard atomizer gun support

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: P. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS

...to be sure of sound welds and fast assembly

L

TO MARK PROGRESS

Keeping welding costs down to a minimum and erection schedules on time... these are important advantages you can assure to any piping job by installing Ladish Controlled Quality fittings. Metallurgical controls over materials and methods provide an assurance of uniform weldability in every Ladish fitting... and thorough inspection to rigid standards of physical dimensions and geometric accuracy assures fast piping assembly.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • Havana • Toronto • Mexico City

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH R/M

Raybestos-Manhattan not only makes packings for centrifugal pumps like this, but for rotary and reciprocating pumps, compressors, valves, engines, hydraulic rams, and practically every other type of fluid handling or fluid-actuated equipment. See your nearby R/M distributor. Or write today for the new R/M Catalog.

PACKINGS

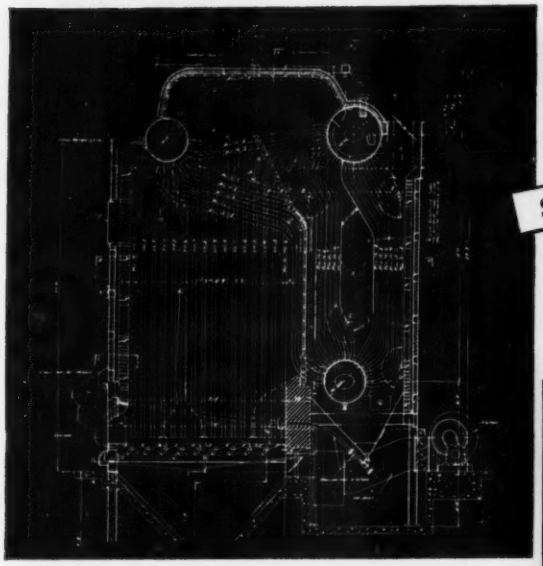
RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Powdered Metal Products • Bowling Balls

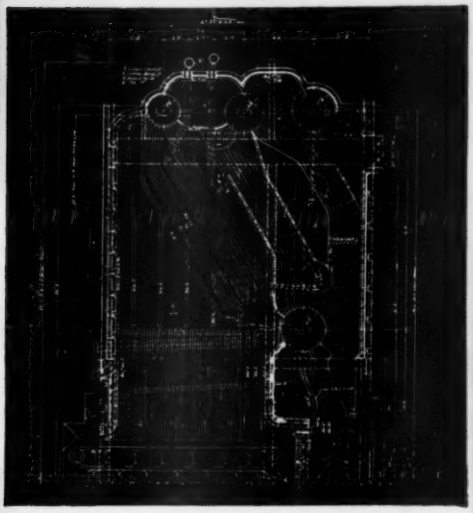
Quick Steaming at all Ratings!



Carry high overloads with high efficiency

SPECIFY Vogt

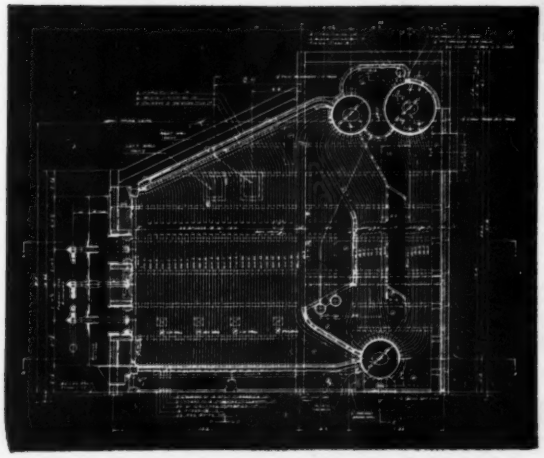
STEAM GENERATING UNITS



CLASS VL Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

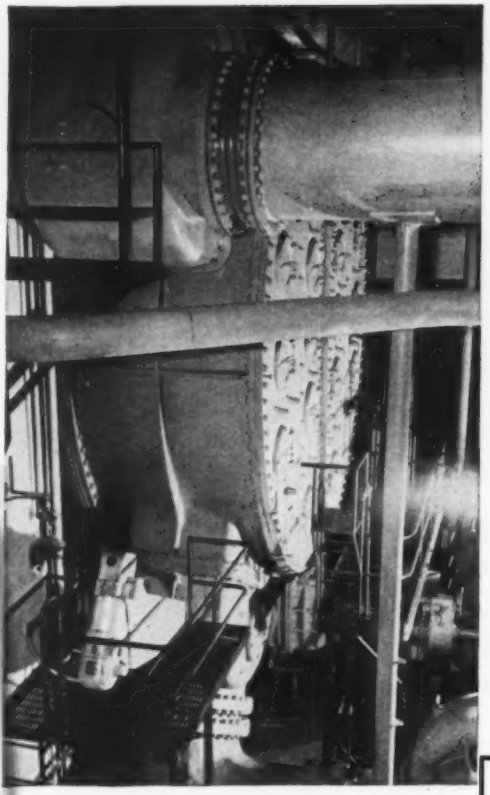
HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES:
NEW YORK, PHILADELPHIA, CLEVELAND
CHICAGO, ST. LOUIS, DALLAS

"SELF-CLEANING" CONDENSER

Eliminates 2 to 3 HOURS Daily Down-time



HERE'S HOW THE "REVERSE FLOW" PRINCIPLE WORKS ⟶

Both halves of this Dual Bank Condenser work the same but independently of each other.

Left Side: Water enters divided water box at valve chamber A, with left port open. It flows through pass B to end of condenser, back through pass C and out through upper port of D.

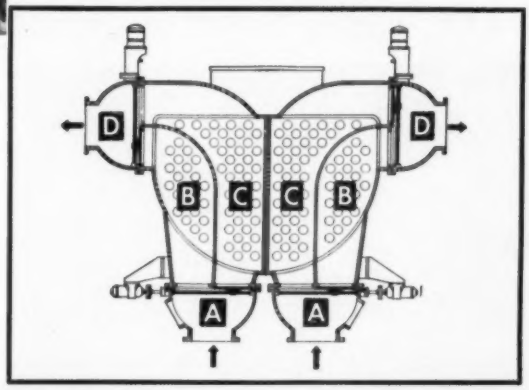
Right Side: Flow is reversed: Valves at inlet A and discharge D are changed to permit water to flow through C and back through B in the opposite direction, then out through lower port of D.

At Plant Atkinson, Harryat, Georgia, the Georgia Power Company draws circulating water from the Chattahoochee River. The inevitable sand, gravel, twigs and leaves used to clog condenser tubes and tube sheets in a matter of hours. Before the installation of a C. H. Wheeler Reverse Flow "Self-Cleaning" Condenser, it was a two- to three-hour job every day to remove anywhere from ½ to 2 yards of debris by hand. During this time, it was necessary to drop the load on the turbine to about half in order to operate against excessive back pressure.

Since September 5, 1949, when a C. H. Wheeler "Self-Cleaning" Condenser was installed, there hasn't been a single shut-down for cleaning. The Reverse Flow mechanism works flawlessly 24 hours a day, with 70,000 gallons per minute of river water passing through. The only cleaning is done by means of the electrically operated valves that reverse the flow of water through the condenser without interfering in any way with plant operation. This is done as often as necessary in a matter of minutes.

Through eliminating down-time for condenser cleaning, approximately *one month* of full capacity operation is added to the service of one of the four 60,000 KW turbo-generators in this 240,000 KW plant.

You, too, can benefit by C. H. Wheeler Engineering. Whether or not you need the self-cleaning Reverse Flow feature, it will pay you to "Investigate C. H. Wheeler Condensers before you Invest."



C.H. Wheeler OF PHILADELPHIA

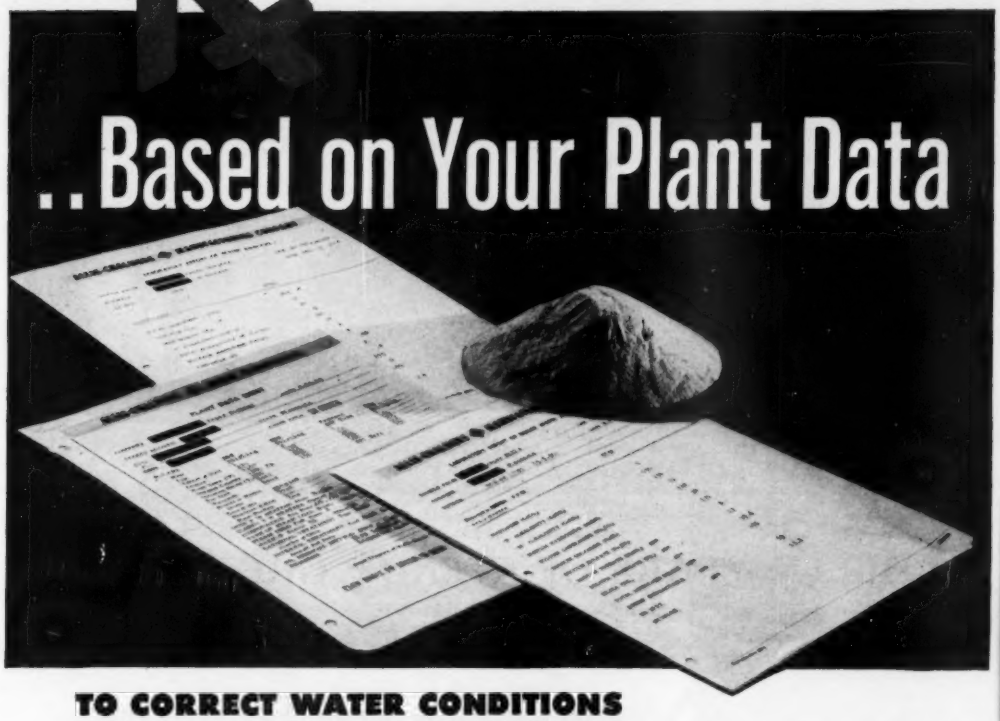
STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

C. H. WHEELER MANUFACTURING CO., 1802 SEDGLEY AVE., PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES

℞ ALLIS-CHALMERS No. 30 SERIES Boiler Feedwater Treatment

..Based on Your Plant Data



TO CORRECT WATER CONDITIONS USE THE CORRECT TREATMENT

THE RIGHT PROTECTION in the right amount is given by Allis-Chalmers No. 30 Series powder formulations — protection against scale, corrosion and embrittlement (if required). The materials used, their proportions and the rate of feeding are prescribed by Allis-Chalmers specialists, and each formulation is based on the characteristics of the plant it is to serve.

There are no secrets connected with No. 30 Series treatments. These formulations are the logical chemicals in the proper proportions to control undesirable elements revealed by a study of your plant data. No stock "boiler compound" can equal this straightforward, effective internal treatment for boilers in the low and medium pressure ranges.

A trial period for a No. 30 Series treatment can be arranged for your plant if our studies indicate that it will prove helpful.

ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE

FOR A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 30 Series internal treatments, send for bulletin number 28X7531. If you wish, your nearby Allis-Chalmers office can arrange to have your water problem brought before our specialists for study.

Allis-Chalmers
Milwaukee 1, Wisconsin

Gentlemen:
Please send me bulletin 28X7531.

Name .....

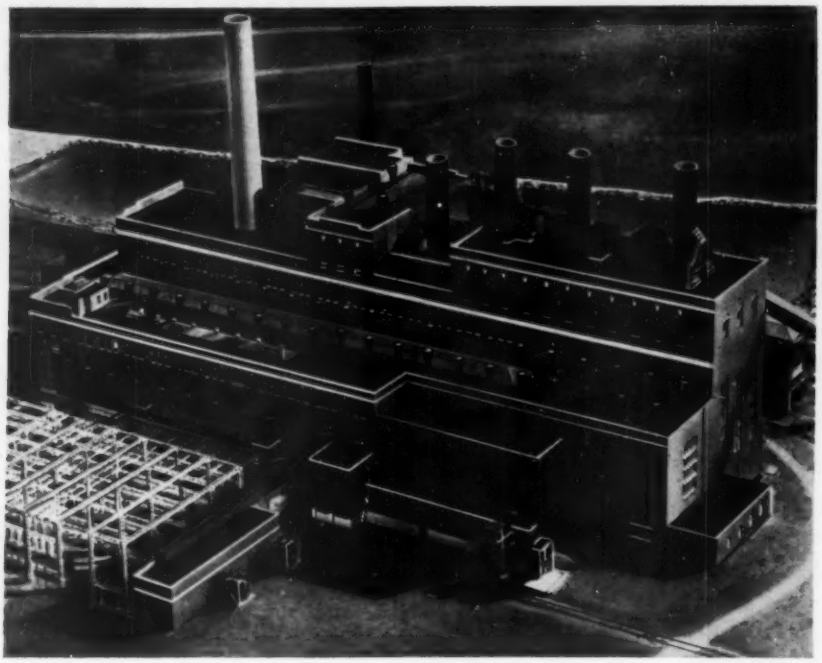
Title .....

Company .....

Address .....

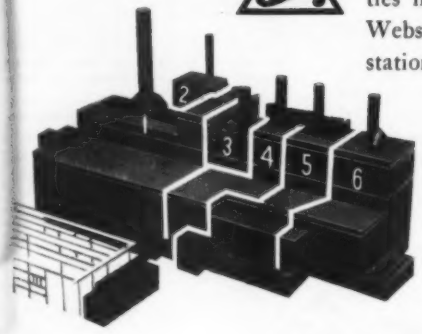
City ..... State .....

A-3376



THIRTY YEARS OF STEADY GROWTH

Since 1920, five additions have been made to the original South Meadow Station of the Hartford Electric Light Company. Many notable pioneering steps in the design of power facilities have been incorporated in this famous plant. Stone & Webster Engineering Corporation was retained for the entire station, including the latest 45,000 kw turbo-generator unit.



1 · **1920** — original station built on the South Meadows, Hartford, Conn.

2 · **1927** — the first commercial mercury turbine was installed at this plant — a bold advance in the development of power.

3 · **1930** — extension included one more steam unit bringing the capacity of the station to 90,000 kilowatts.

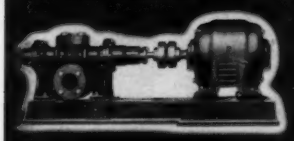
4 · **1937** — installation of a 45,000 kilowatt high pressure unit.

5 · **1942** — second 45,000 unit went into operation just in time to meet war needs of vital industries.

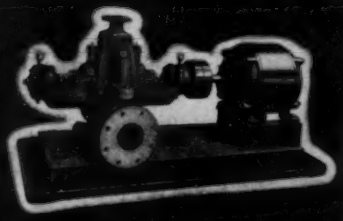
6 · **1949** — extension was built to house #6, the third 45,000 kilowatt high pressure unit to keep pace with area's expansion.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.



Warren-Quimby
Gear-in-head Screw Pump

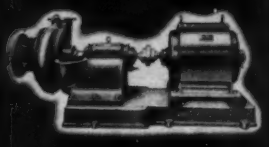


Warren Condensate Pump

Warren Horizontal Duplex
Hydraulic Pump

WARREN PUMPS

Maintain efficiency • Operate at low cost • Are long-lived



Warren Type "L" Single-Stage
Single-Suction Liquor Pump

CENTRIFUGAL

Single and Multi-stage
Pressure range: Up to 1200 P. S. I.
Capacities: Up to 50,000 G. P. M.
Types: Horizontal and Vertical
Impellers: Open or Enclosed

RECIPROCATING

Horizontal and Vertical Single Piston
Horizontal and Vertical Duplex Piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.,

WARREN-QUIMBY SCREW PUMPS

Gear-in-head and External Gear and Bearing
Capacities: Up to 3000 G. P. M.
Pressures: Up to 200 P. S. I. on low viscosity liquids; practically unlimited on high viscosity liquids
Horizontal or Vertical Mounting

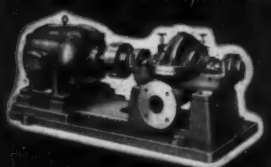
WARREN-QUIMBY ROTARY PUMPS

Gear-in-head and External Gear and Bearing
Capacities: Up to 1000 G. P. M.
Pressures: Up to 250 P. S. I.
Horizontal or Vertical Mounted

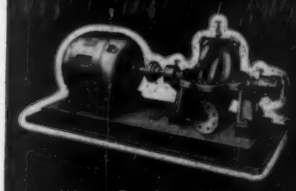
Send your pumping problem to us; Warren Engineers will recommend the right pump for the job.

P-18

Warren-Quimby External Gear
and Bearing Rotex Pump



Warren Type DBL, Single-Stage
Double Suction, Centrifugal Pump

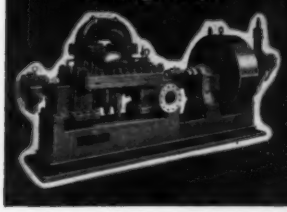


Warren Two-Stage Volute
Centrifugal Pump

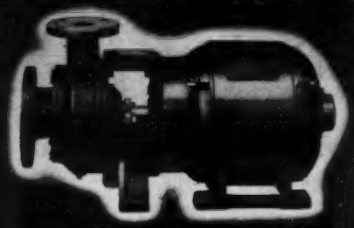
WARREN
QUIMBY PUMPS

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS



Warren 4- and 6-Stage
Centrifugal Pumps

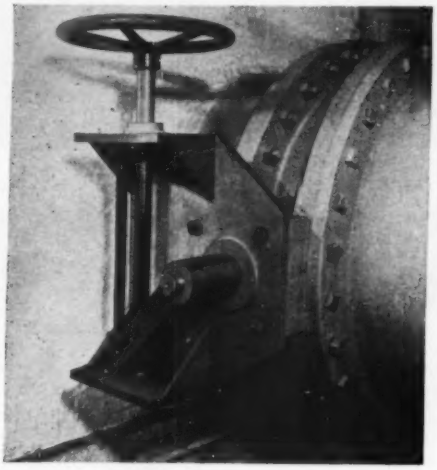


Warren "Compacunit"—4 Types—42 Sizes

Warren Horizontal "Realwear"
Duplex Piston Pump

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



RUGGED Simplicity

Correctly engineered mechanically and metallurgically, all body assemblies of R-S Valves equal or exceed A. S. A. standards in every detail. These valves are designed and constructed for rugged service and provided with such safety factors that they will exceed service expectations as well as reduce pumping and blower costs.

Consider also the few working parts, greater control rangeability, the self-cleaning feature and the fact that R-S Valves are readily adapted to automatic operation. Know the rugged simplicity of R-S Valves, and get the most from your valve investment.

District offices are listed in telephone directories as, "R-S Products Corp'n Valves".

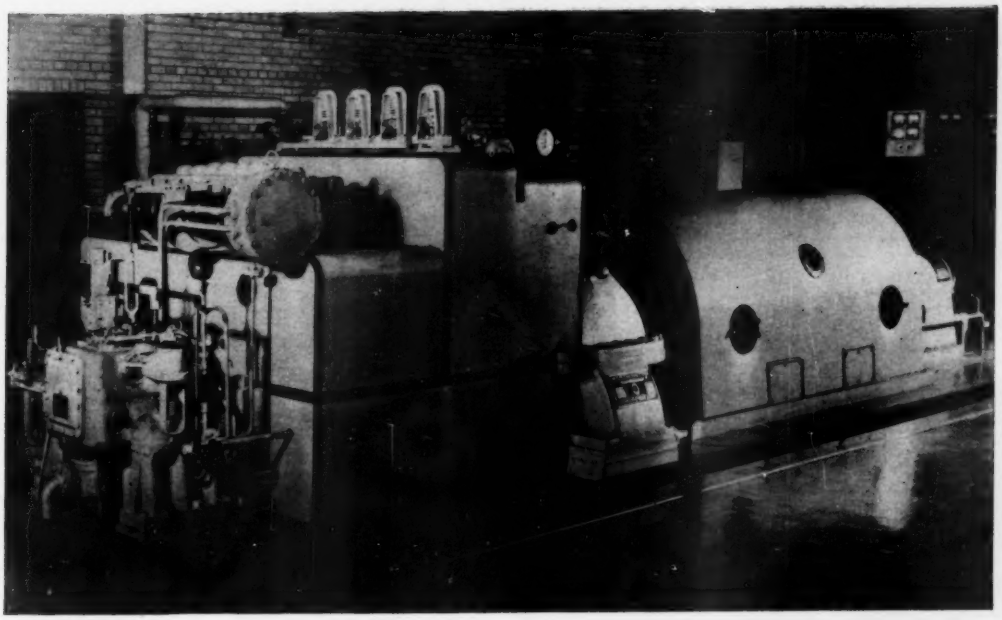
R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

No. 782—Heavy Duty Rubber Seated Wafer Type Valve with 5° angle seated vane and enclosed gear reduction drive. Gland can be removed and stuffing box repacked without removing prime mover.

No. 739-740—Sixty-inch, 50-pound Heavy Duty Valve with gear reduction drive and handwheel for handling water at 40 psig. Vertical valve stem enclosed in steel pipe support. Thrust bearing absorbs vertical load.

No. 730—R-S Heavy Duty Floor Stand for rugged service in connection with any standard R-S handwheel operated valve.

No. 767—A 3-Way Valve (Two 24-inch 125-pound Cast Iron Valves bolted to 125-pound American Standard Tee). Electric motor operated by cross linkage. Automatic declutching handwheel for emergency operation.



Story of an Economy Drive

How the Worthington Steam Turbine Pays Dividends for the City of Litchfield

What happened at Litchfield, Minnesota, is a clue to a most economical power plant operation.

Originally, the Litchfield municipal power plant consisted of low-pressure boilers, a steam engine and a small turbine-generator unit. The exhaust steam is sold for municipal heating.

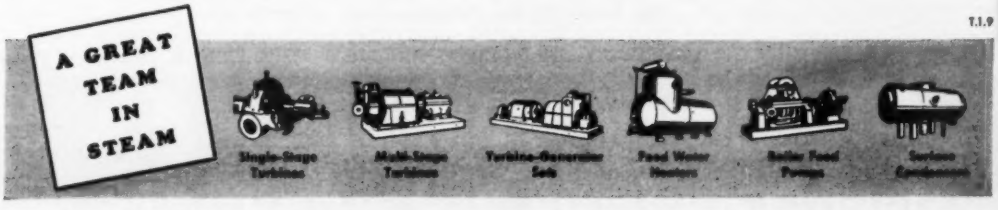
Next—a Diesel engine-driven generator was installed. The load grew, and finally, after a careful survey, it was decided to install a 3000-kw Worthington turbine generator and automatically extract steam for heating purposes.

Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000-kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

WORTHINGTON

STEAM TURBINE GENERATORS

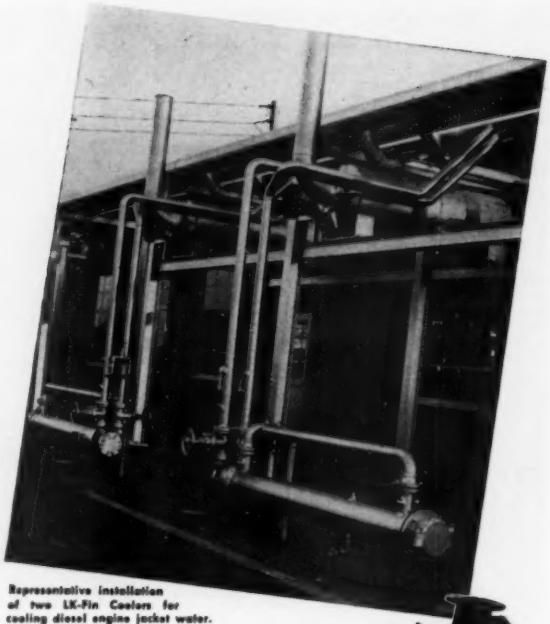
T.I.9



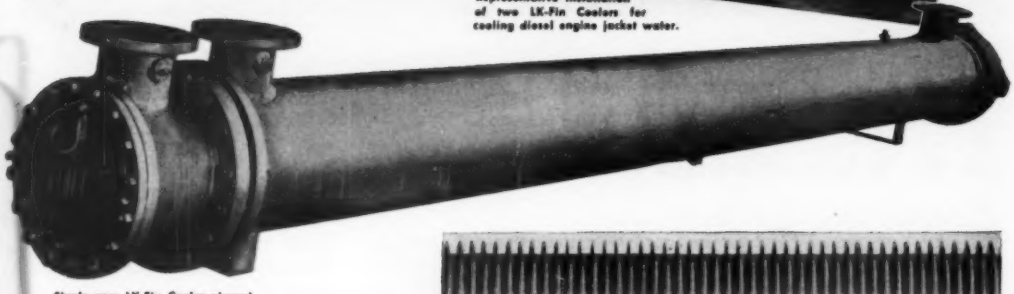
Why **LK-FIN**

means a more effective... compact and economical

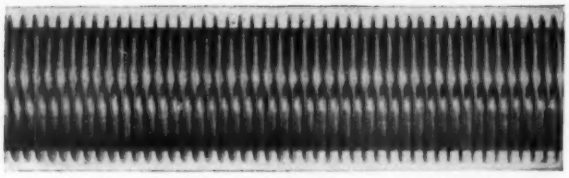
LUBE OIL OR JACKET WATER COOLER



Representative installation of two LK-Fin Coolers for cooling diesel engine jacket water.



Single-pass LK-Fin Cooler viewed from stationary head end



Portion of the helical-finned element used in the LK-Fin Cooler

It's because of the *fins* on the cooling elements. These fins greatly increase the external heat transfer surface . . . enable a considerably shorter tube to perform the same cooling effect that requires a much longer bare tube.

The results . . . a more compact cooler because of the more effective heat transfer surface . . . a more economical unit because of the shorter tubes and shell.

What diameter . . . thickness . . . pitch . . . should the fins be to accomplish these results? That's where G-R's unmatched know-how comes in . . . a knowledge gained from 20 years of experience in building *finned-type* heat exchangers and the results obtained from many tens of thousands of installed finned-tube units.

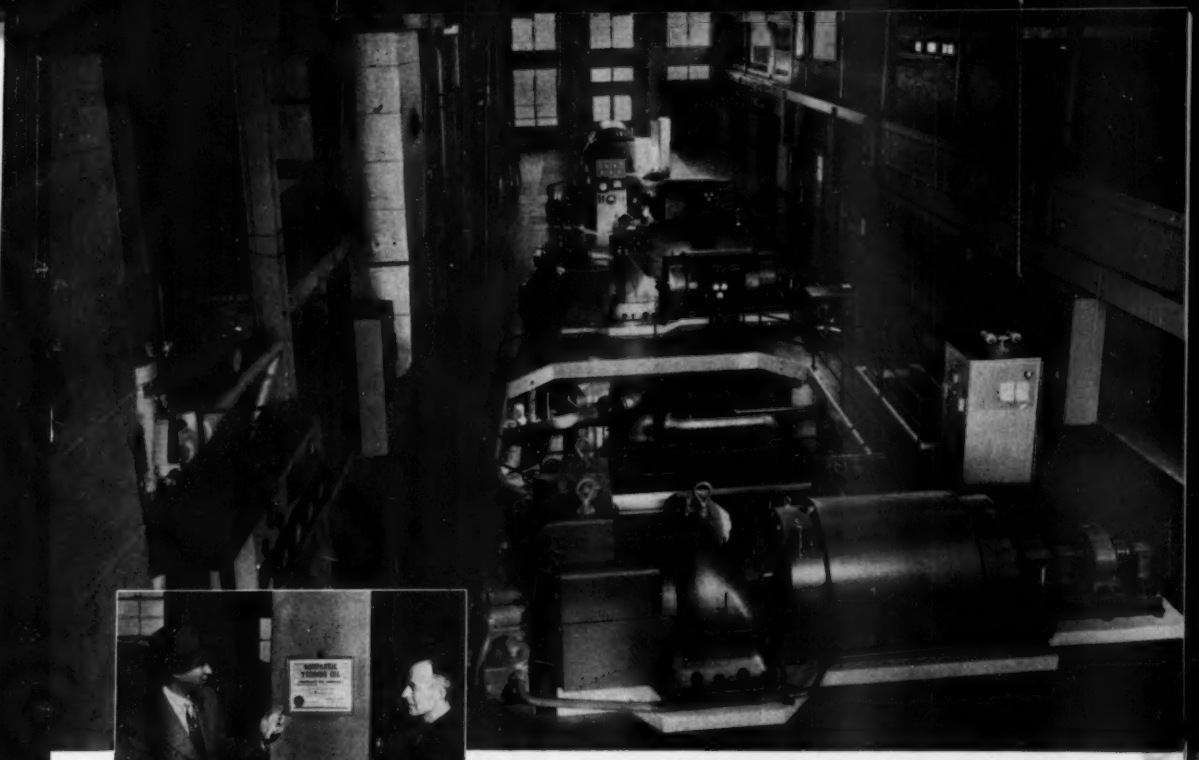
And the exclusive use of LK-Fin tubes is only one of the many distinctive features of these coolers. Write for bulletin describing them in detail, with rating tables and selection data.

THE GRISCOM-RUSSELL CO., 285 MADISON AVE., NEW YORK 17, N. Y.

GR-303

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS



Above: Shown are four of the five big turbines of the Colorado Springs Municipal Utilities. NONPAREIL Turbine Oil helped operators "wash their hands" of oil-system maintenance troubles.

Left: J. J. Tyler (left), Standard Oil lubrication specialist, and W. J. Whelan, plant engineer, discuss the written guarantee given with each fill of NONPAREIL Turbine Oil.

Washed their hands of turbine-lubrication trouble!

NONPAREIL
TRADE MARK
Turbine Oil

Operators of the Colorado Springs Municipal Utilities had their hands full keeping oil systems clean in three big turbines. At least once a year, sludge and varnish had to be removed from the lubricating systems. Moreover, gradual deterioration of the lubricant used in the turbines made it necessary to replace fills of oil approximately every three years.

The recommendation of a Standard Oil lubrication specialist changed all of that. Operators took his advice and switched their turbines to NONPAREIL Turbine Oil.

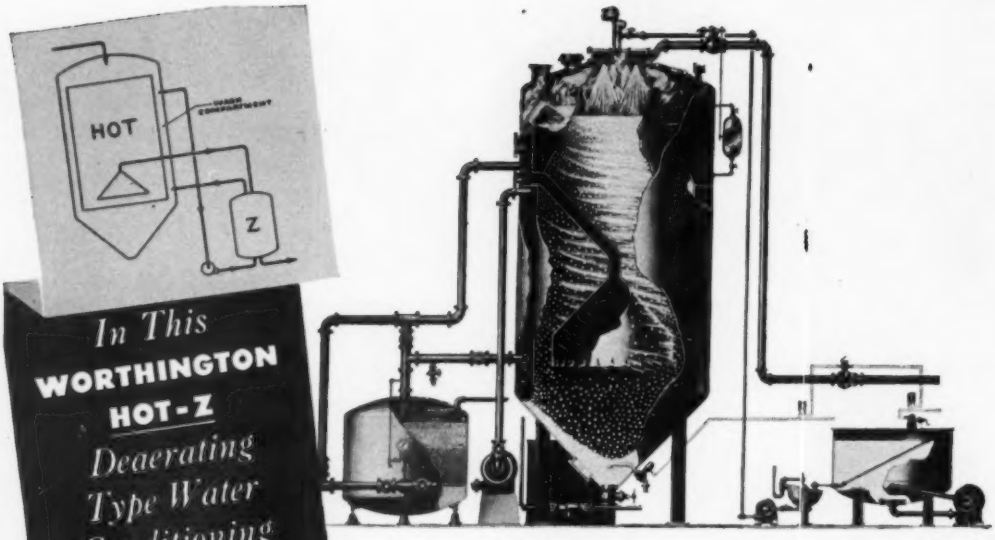
Throughout ten years of operation, oil systems have stayed clean. The original fills of NONPAREIL have shown no appreciable deterioration, and neutralization numbers have remained below 0.10 KOH/gm. As a result, no fill of oil has needed to be replaced. The men of the Colorado Springs Municipal Utilities report: trouble-free lubrication by NONPAREIL has pared lubrication and maintenance costs to the bone! Since the switch to NONPAREIL, two new turbines have been added. Both of these units are lubricated with NONPAREIL Turbine Oil.

Trouble-free, low-cost lubrication is assured the Colorado Springs Municipal Utilities not only for 10 or 15 or 20 years but for the life of their turbines. This assurance is based on a written guarantee, given with each fill of oil to all NONPAREIL users, that NONPAREIL Turbine Oil will maintain a neutralization number below 0.15 KOH/gm. for the life of the turbine it lubricates. NONPAREIL has borne out its guarantee by having served, in individual turbines, for as long as 22 years without once being removed or replaced.

Ask a Standard Oil lubrication specialist to show you actual case histories from utility plants where NONPAREIL has reduced lubrication costs as much as 65%. You can reach a lubrication specialist by phoning your local Standard Oil Company (Indiana) office. Or, write:

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD **STANDARD OIL COMPANY (INDIANA)**



In This **WORTHINGTON HOT-Z** *Deaerating Type Water Conditioning System . . .*

Built-In Annular Wash Water Compartment Supplies and Reclaims Backwash Water

Independent of the Softening Process

No other Hot Zeolite System offers you so many advantages as this Worthington Hot-Z System. A quick review of the vital facts will show you why.

As you probably know, Hot Zeolite beds require periodic expansion to minimize packing and friction loss, and to insure efficient contact of each Zeolite particle with its share of dissolved impurities. This need for bed expansion occurs not only during the regeneration routine, but also several times during the period between regeneration routines. That's why it is important for you to use clean, softened water, preferably at normal operating temperature, for the reverse flow or "backwash" operation.

Worthington does it!

The Worthington Standard Hot-Z System with its backwash feature provides a built-in annular wash water compartment that supplies and reclaims backwash water . . . independent of the system's softening process. In this compartment, backwash water is cleaned and maintained at normal operating temperature.

This backwash feature pays off particularly in systems employing filters because it *makes filter beds last as long as eight years.*

Other advantages

Worthington Hot Process Systems come equipped with modern, direct contact vent condensers. This means, no more of the scaling trouble that made the old-fashioned shell and tube types such a nuisance.

In addition, Worthington Hot-Z Systems operate on low-priced lime and salt. That's why the average installation saves enough in chemical costs to pay for itself in 3 years.

Get all the facts!

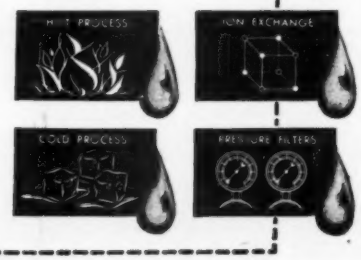
It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find in our Hot-Z System, as in so much other equipment, *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Section, Dunellen, N. J.*

J1-1

WORTHINGTON

WATER CONDITIONING

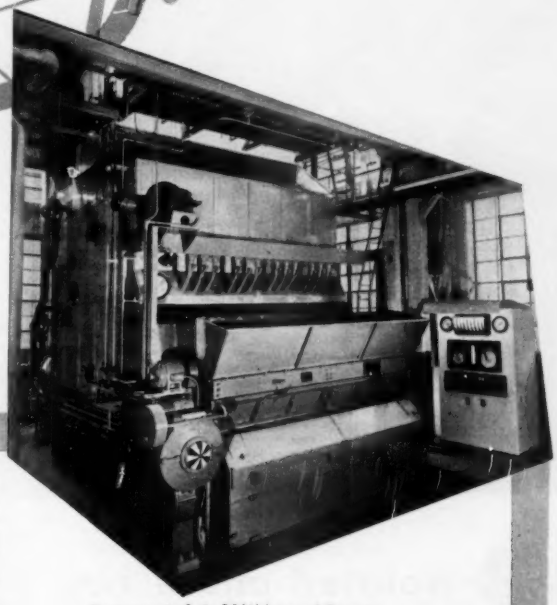
Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



FALSTAFF

reduces costs... maintains Premium Quality

with B&W STEAM



Most recent of six B&W Integral-Furnace Boilers, installed in Falstaff breweries at St. Louis, Omaha and New Orleans.

Local unwashed Illinois coal is $1.10 a ton cheaper than the higher, washed grade formerly required by the Falstaff Breweries' natural draft stokers. When a new B&W Integral-Furnace Boiler, Type FF was installed in their St. Louis plant No. 5, Falstaff enjoyed an initial saving of 25% on fuel costs.

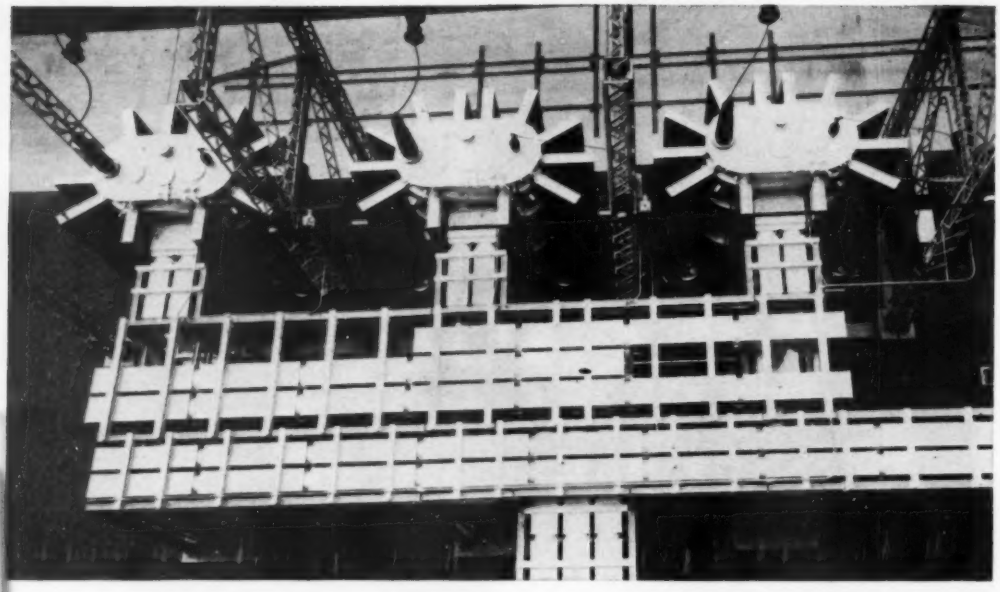
And that wasn't all . . . with the new B&W unit, they squeezed more efficiency from the cheaper fuel by increasing the rate of evaporation from 6.6 pounds of steam per pound of coal to 8.4 pounds . . . bringing fuel savings to a total of 45%!

Sudden load surges typical of brewery requirements are met with ease. Steam loads can be increased 15 to 20% within a matter of seconds without carryover or loss of pressure. Whatever your business, the use of B&W's 80 years' experience in boiler improvement is sure to be appreciated by your plant engineers and cost accountants. The Babcock & Wilcox Co., 85 Liberty St., New York 6, N.Y.

BABCOCK & WILCOX

G-526

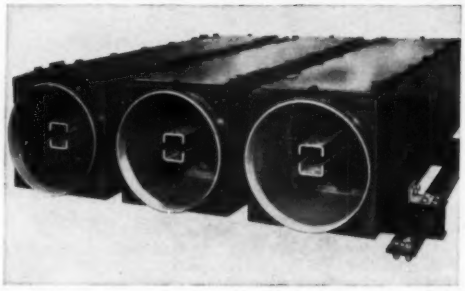
Vital Station Interconnections Get Maximum Protection



isolated-phase bus

With G-E isolated-phase bus runs for vital interconnections between generators, transformers and main switchgear, you know that every precaution is taken to insure freedom from faults of every type. Dust-tight, weather-tight aluminum construction seals out many possible causes of flashover. Advanced G-E design reduces the number of creepage surfaces without sacrifice of mechanical strength. Supplied in either individual-phase sections or as a complete three-phase package, G-E isolated-phase buses simplify installation problems and cut costs.

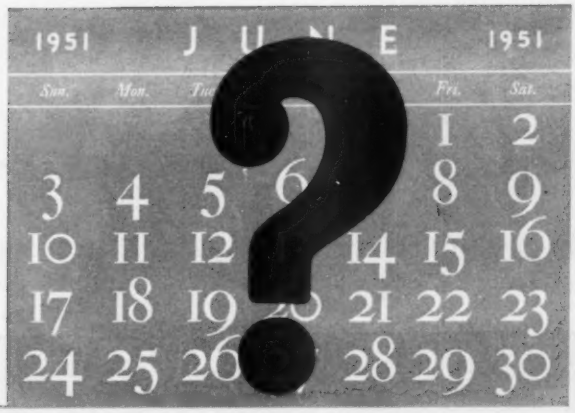
Your G-E sales representative has complete information. Ask him for a copy of GEA-5460, a 28-page publication that will aid you in planning your buses, or write to General Electric Company, Schenectady 5, N. Y.



Typical three-phase section of G-E isolated-phase bus. Bus is copper, channel-type to provide maximum strength. Silver contact surfaces assure full flow of current and eliminate oxidation troubles. Insulators conform to NEMA standards, are normally carried in stock in power stations. Gasketed, aluminum cover has two sets of hinges to permit opening from either side. Lugs release covers without removal of any bolts. End bells are welded to housing. Adjacent ring flanges are tightly joined by split aluminum bands whose mating edges are also gasketed.

855-26

GENERAL ELECTRIC



What Day This Month Will Corrosion Knock Out Your Steam And Condensate Lines?

It can happen any day. *Corrosion* may be active in your plant *now*—in your steam and condensate lines, your process equipment—ready to destroy!

But whatever day failure occurs . . . you can be sure of one thing. It's going to be expensive! Many times more costly than *proper* corrective treatment.

Drew prevents corrosion by a study and investigation of *your* plant operations and water conditions. It analyzes those conditions in its modern laboratories and *insures* improvement of operation by specific recommendation for corrective treatment.

Thoroughness of investigation and proper treatment have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew's Boiler Water Treatment and Steam Line Corrosion Control. Do the same. Consult the nearest Drew engineer or write for further information.

Have the Drew engineer check the corrosion in your plant with a corrosion tester.

Send for Technical Bulletin on Steam Line Corrosion Control. Write for your copy today.

POWER DREW CHEMICALS

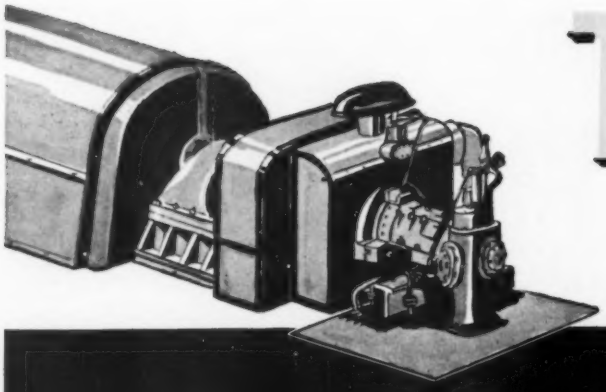
Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

Nationwide Service in Boiler Water and Cooling Water Conditioning

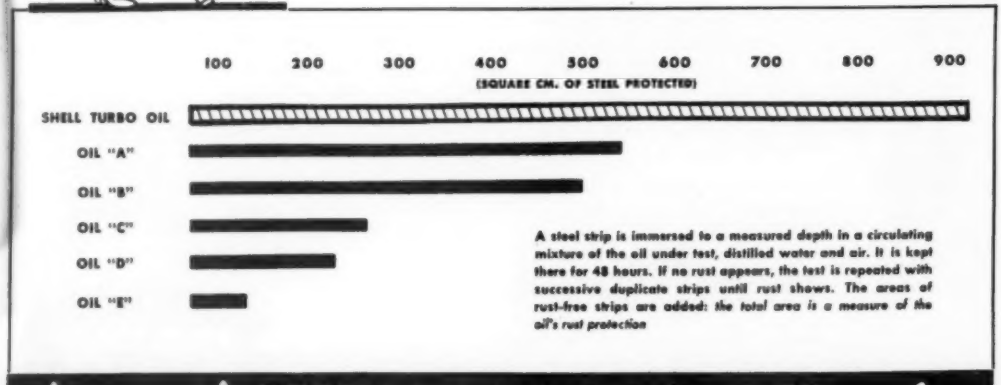
DREW PRODUCTS



Today's

Improved SHELL TURBO OIL

"LOOK AT THESE RUST-PROTECTION FIGURES"



A steel strip is immersed to a measured depth in a circulating mixture of the oil under test, distilled water and air. It is kept there for 48 hours. If no rust appears, the test is repeated with successive duplicate strips until rust shows. The areas of rust-free strips are added: *the total area is a measure of the oil's rust protection*

Improved SHELL TURBO OIL for

Surest Safeguard

for MAJOR TURBINE INVESTMENT

The one lubricant that provides this

outstanding 5-way protection

Because of the tremendous responsibility entrusted to operators of large steam turbines, and because of the heavy investment each unit represents, Shell Oil Company has been concentrating on a lubricant research project of primary importance to utility and industrial executives.

The product now offered, Improved SHELL TURBO OIL, exceeds *every* accepted specification for premium turbine lubricants. It offers these five outstanding improvements:

1. **Highest known rust protection**—An entirely new combination of rust inhibiting additives effectively retards the formation of rust—an action which with proper maintenance will continue for the life of the turbine. Rusting problems are reduced to the very minimum in any turbine protected by Improved Shell Turbo Oils.

2. **Outstanding Oxidation Stability**—Improved Shell Turbo Oil contains the same time-proved anti-oxidant which has compiled such an extraordinary record of oxidation stability in the original Shell Turbo Oil. Service records for turbine units of all sizes . . . many operating for 10 to 13 years . . . show complete stability with respect to oxidation and sludge formation. In each of these units the oil gives every indication of matching the operating life of the turbine itself.

3. **Anti-foaming**—With the effective anti-foam agent now in Shell Turbo Oil, air entrainment can be tolerated for considerable periods, thus avoiding unscheduled shutdown.

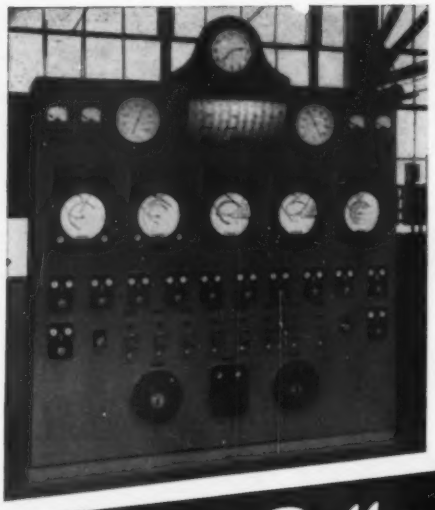
4. **Excellent Emulsion Characteristics** — Improved Shell Turbo Oil provides the greatest protection against rust and oxidation yet achieved. Moreover, this protection is attained without any tendency to form objectionable water emulsions in service.

5. **Protection against wear**—The specially developed rust inhibitor used in Improved Shell Turbo Oil has the added faculty of reducing surface wear . . . adding to the protection afforded by the Oil itself. Because of this "anti-wear" effect, Shell Turbo Oil provides a welcome margin of safety for the bearings and gears during the critical starting and stopping periods.

Samples and complete information on the Improved Shell Turbo Oil will be sent promptly on receipt of your letterhead request. Address: Shell Oil Company, 50 West 50th Street, New York 20, N.Y. or 100 Bush Street, San Francisco 6, California.

SHELL

central station and industrial turbines



This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

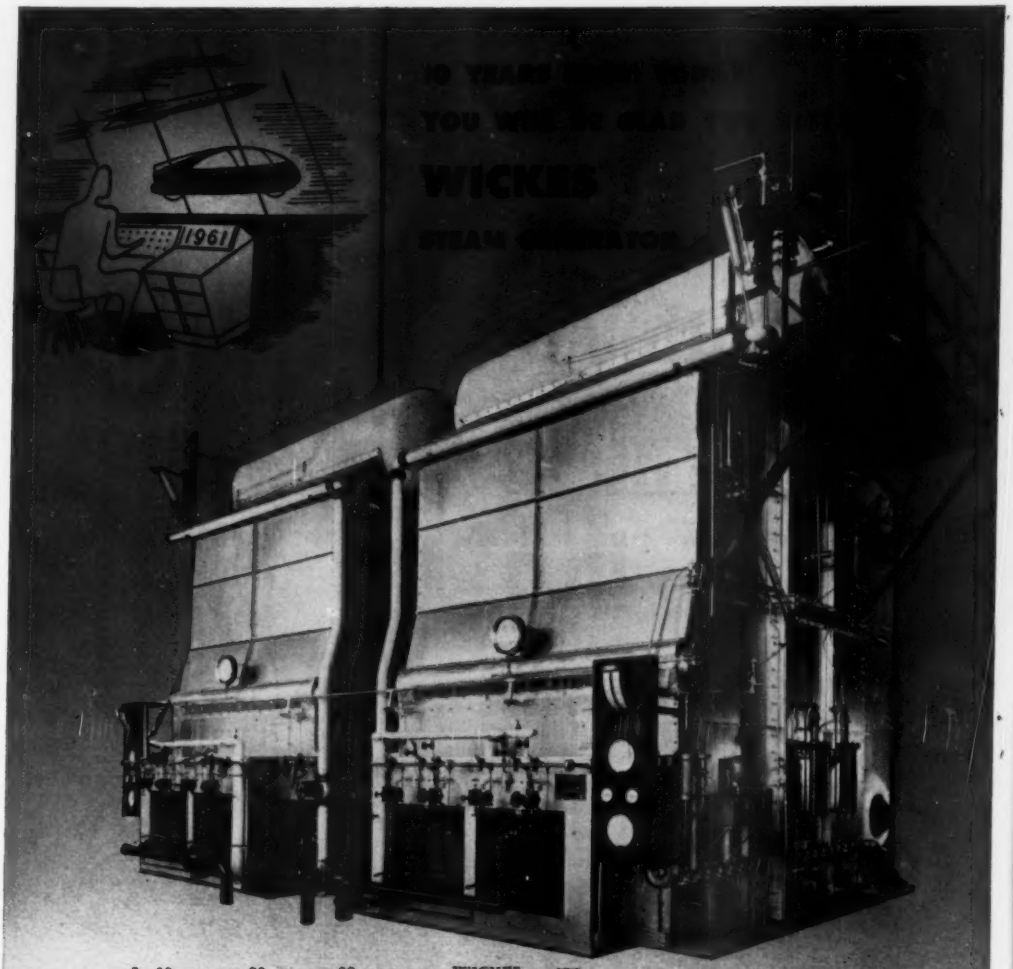
A-112-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS



In 10 years or 20 or even 30 years, your WICKES Boiler will still be going strong. For almost a century now, The Wickes Boiler Company has been leading the field in the manufacture of efficient high-pressure water tube boilers that are really built to last. Throughout the world, industries that depend on steam have learned by long experience that they can depend on WICKES Steam Generators. The Type S 2-Drum Boilers shown here have found wide acceptance in the chemical processing industry because they *are adaptable to any standard method of firing*—oil, gas, single retort underfeed or spreader stoker. Each of these Type S Boilers is capable of delivering 35,000 lbs. of steam per hour. And the low head design makes them especially practical where space is limited. WICKES can fill your requirements for steam generators up to 250,000 lbs. per hour and 950 lbs. per square inch. If you have a boiler problem, our knowledge and experience *is available to you without obligation* . . . write today for descriptive literature on WICKES' complete line of steam generating equipment.

WICKES

THE WICKES BOILER CO.

SAGINAW, MICHIGAN

DIVISION OF THE WICKES CORPORATION

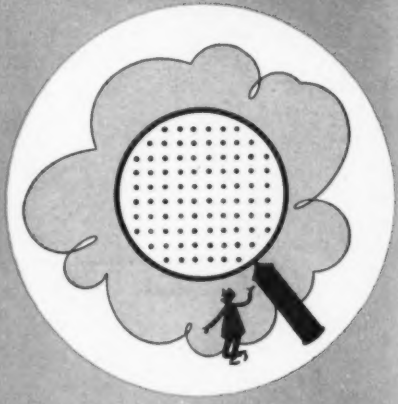
RECOGNIZED QUALITY SINCE 1854

132

SALES OFFICES: Atlanta • Boston • Chicago • Cincinnati • Denver Detroit • Houston • Indianapolis • Los Angeles • Milwaukee • New York City • Pittsburgh • Saginaw • San Francisco • San Jose Springfield • Seattle • St. Louis • Tulsa • Mexico City • Buenos Aires • Manila • Havana • Montevideo • San Juan, P.R. • Victoria, B.C.

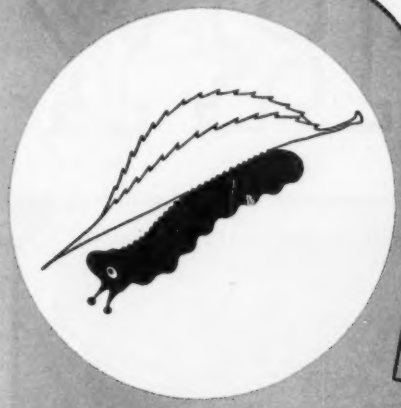
Whatever you need in a Steam Cylinder Oil...

Quick ATOMIZATION



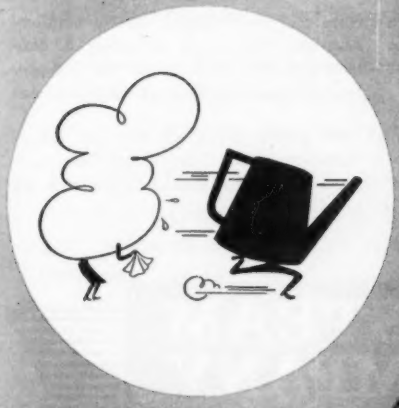
DISTRIBUTION throughout the steam

HIGH TEMPERATURE resistance



ADHESION to cylinder walls and valves

RESISTANCE to washing off lubricated surfaces



Complete SEPARATION from condensate

Sinclair has it!

No matter what your operating conditions—
pressure, temperature, quality of steam; speed, loading;
condensing or non-condensing—
there is a Sinclair Steam Cylinder Oil made expressly
to give the utmost in lubrication satisfaction.

Through proper combinations of steam cylinder stocks and compounding ingredients, Sinclair lubrication technologists have developed a series of steam cylinder oils to fit the operating needs of any installation. There are oils that provide quick atomization . . . persistent adhesion to cylinder walls in the presence of moisture . . . rugged, wear-resisting lubricating films under super-heat . . . or complete separation from condensate where that is the dominating requirement.

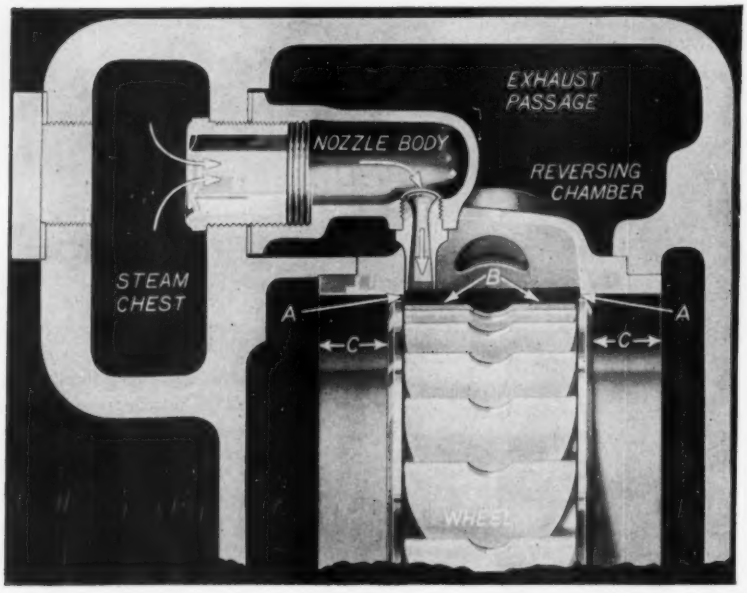
A Sinclair lubrication engineer will help you select the proper oil for your particular service.

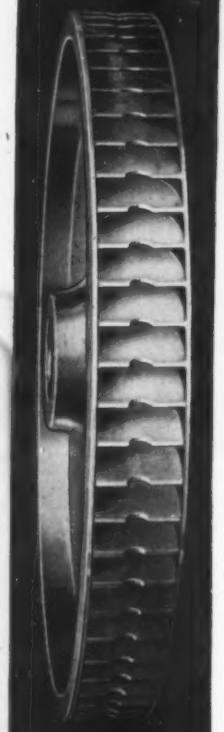
SINCLAIR
Steam Cylinder Oils

for every steam engine installation

For lubrication counsel see your nearest Supplier of Sinclair Products or write Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.

TERRY





AMPLE CLEARANCES FOR DEPENDABILITY

Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

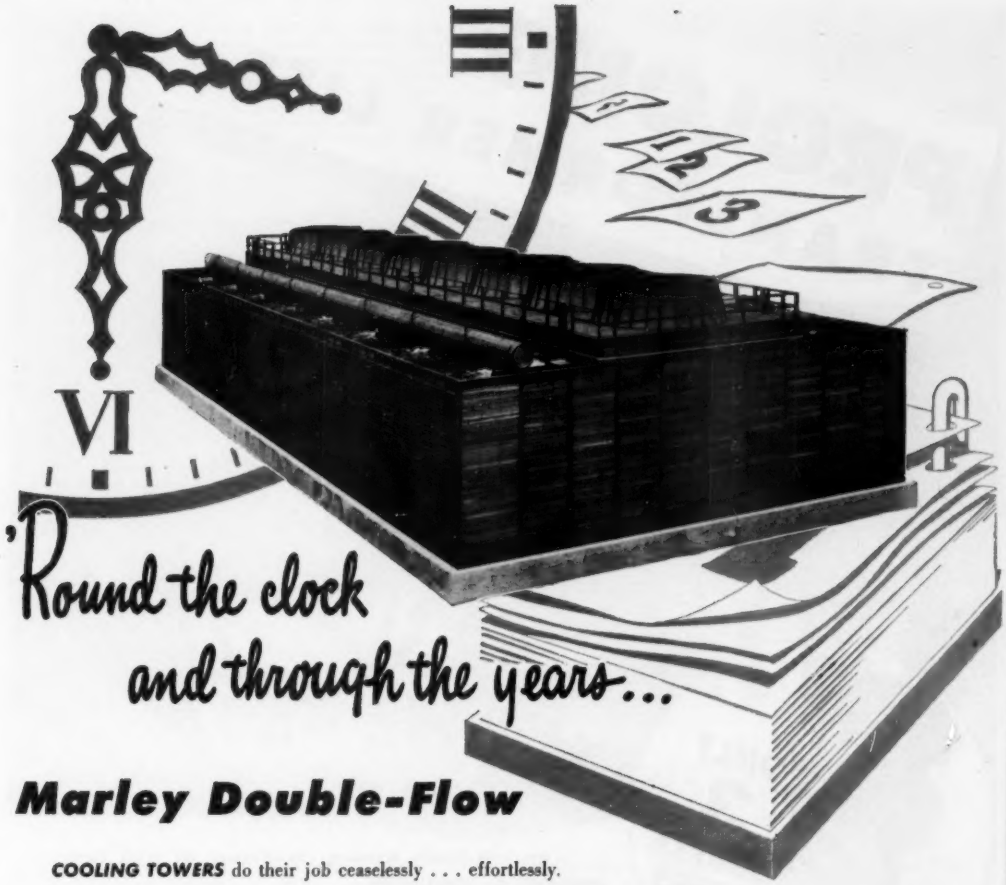
The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

Note the rim clearance, AA in diagram. Also the large blade clearance, B. Side clearance, CC, is so large that end-play from external thrust cannot damage wheel.

Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



'Round the clock
and through the years...

Marley Double-Flow

COOLING TOWERS do their job ceaselessly . . . effortlessly.
Designed for long-service life, Double-Flow dependability is further assured by the patented design that makes possible "at-a-glance" inspection, on-the-spot maintenance—all without service shutdowns or lag in plant production.

The famous Marley open distribution system keeps the operator informed at all times on water conditions, and may be cleaned in minutes, during operation. By merely opening a door, the operator can walk through the entire tower, inspecting all essential parts as the Double-Flow continues to do its duty.

Marley fans, Geareducers, drive shafts—all designed for cooling tower service exclusively—are keyed to this same service simplicity. Mechanical equipment . . . distribution . . . filling . . . basin . . . from top to bottom and side to side, Double-Flow towers and *only* Double-Flow towers are an open book to the tower operator—a book that tells a story of ceaseless, effortless operation.

The Marley Company, Inc.
KANSAS CITY 15, KANSAS

MARLEY

PROLONG TRANSFORMER LIFE

ONLY 3 SIMPLE STEPS

1. The Bowser method atomizes oil into minute particles to expose maximum surface area.
2. Volatile contaminants are then completely removed by high vacuum.
3. Dry colloidal particles are removed by microfiltration.

. . . by periodically treating transformer oil with Bowser insulating oil conditioners.

A survey of thirty utilities, continuously using this method of preventive maintenance for six years, revealed *not one transformer failure due to contaminated oil!* Transformers remained energized while the insulating oil was processed.

Best of all, this method eliminated replacement of insulating oil as well as its removal to a central point for reclamation with fullers earth or chemical treatment.

LOW COST—HIGH DIELECTRIC

The average cost of preventive maintenance was less than one cent per gallon per year. Oil dielectric was kept above 35 k.v. with a single pass, and the water soluble acid content was nearly zero.

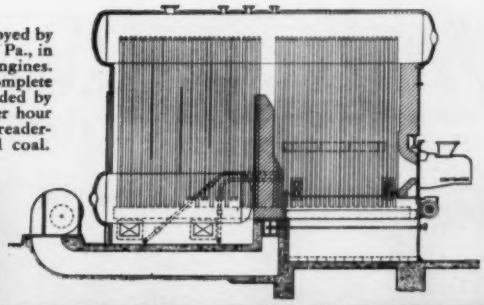
NOW is the time to reduce your maintenance costs!
Write today for all the facts on Bowser conditioners.

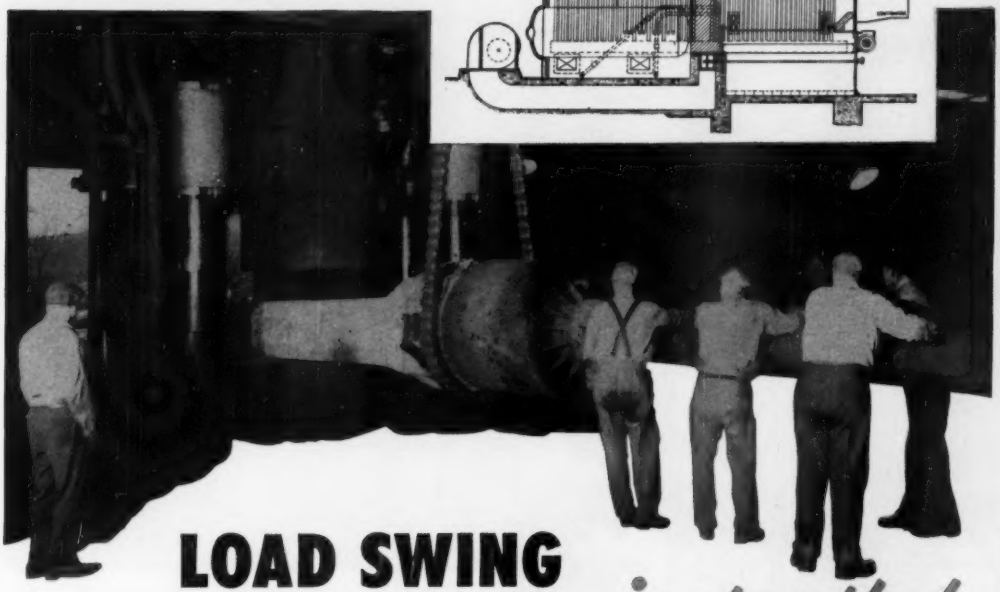
BOWSER STANDARDIZED

BOWSER, INC., 1351 CREIGHTON AVE.
FORT WAYNE 2, INDIANA

LIQUID CONTROL SPECIALISTS SINCE 1885

This 2000-ton press is the larger of two employed by the Ellwood City Forge Company, Ellwood City, Pa., in shaping huge crankshafts for the largest diesel engines. Steam for these giant presses, as well as a complete forge-hammer shop, and plant services, is provided by a Keeler Type CP Boiler, 30,000 lbs. steam per hour maximum, fired by a Centrafire (Westinghouse Spreader-Type Stoker) with Link-Grate, burning local coal.





LOAD SWING

from zero to 30,000 lbs. *instantly!*

As the giant presses and forge hammers at Ellwood City Forge Company are turned on and off, load upon the boiler . . . and the stoker . . . swings *instantly* from 10,000 to 30,000 lbs. . . . and back again, just as suddenly. In summer the swing is from zero to 30,000 lbs!

That's a grueling test of flexibility and dependability in the stoker, which must provide an instant inrush of heat to maintain pressure on the upswing . . . and must cut off cleanly to prevent boiler popping on the downswing.

Prior to installation of a Westinghouse Centrafire® with Link-Grate, the hammermen were starved for steam . . . were handicapped and slowed down in working the metal; costly reheats were often required. Boiler popping lost expensive steam to the atmosphere.

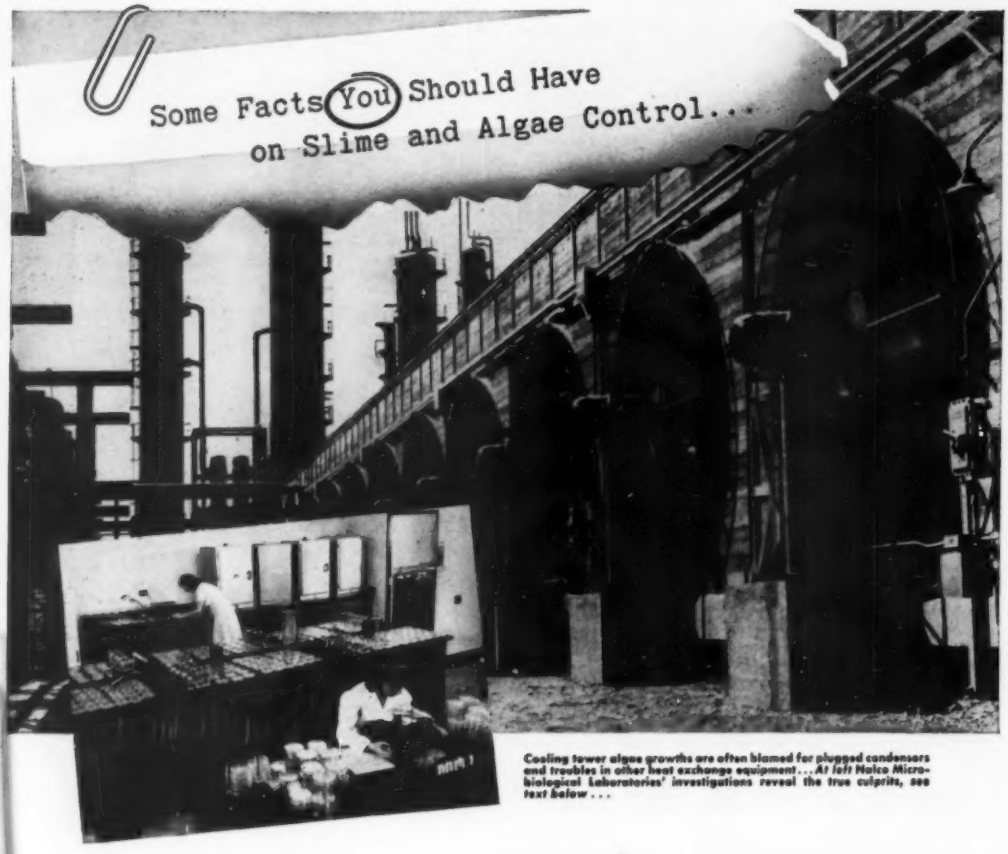
The Westinghouse Centrafire with Link-Grate, however, has ended these troubles. It follows the load . . . up or down . . . with a flexibility characteristic of the Centrafire. Moreover, with steam flow cut to zero for up to six hours between shift changes, the Centrafire holds the fire. And . . . there has been no forced shutdown of this unit since its installation.

You can have the flexibility . . . the reliability . . . the low operating and maintenance costs of a Westinghouse Stoker with any boiler of your choice. A Westinghouse Stoker Application Engineer is as near to you as your telephone . . . or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-50329

YOU CAN BE SURE . . . IF IT'S

Westinghouse

STOKERS



Cooling tower algae growths are often blamed for plugged condensers and troubles in other heat exchange equipment... *At left* Nalco Microbiological Laboratories' investigations reveal the true culprits, see *text below*...

ALGAE, the trouble-makers in cooling towers, seldom cause plugging, corrosion or iron oxide deposits in other parts of cooling systems ... Nor can mold growths, slime-forming, sulfate-reducing and iron-depositing bacteria that do cause these internal difficulties be controlled with most algae-killing chemicals.

These established facts make it obvious that proper control of microbiological growths in any cooling system is first a job for experts. Proper identification, selection of treatment chemicals and dosages, and proper points of application will be handled efficiently and economically in your plant by Nalco Field Representatives, working closely with the Nalco Laboratories. Once proper microbiological control is established, consistent supervision to check effectiveness of treatment is all that is necessary to insure clean, slime- and algae-free equipment throughout your cooling system.

Your copy of Nalco Reprint No. 6, "A Practical Approach to the Problem of Cooling-Water Slime," will be sent promptly upon request ... If your slime and algae control problem requires corrective action, now, write or call for a Nalco Field Representative.

FORMULA FOR SUCCESSFUL SLIME AND ALGAE CONTROL

- Identify slime-forming organisms to be controlled.

A NALCO SERVICE

- Determine the best types of treatment to be used.

A NALCO SERVICE

- Determine, by detailed survey, the proper method of application.

A NALCO SERVICE

- Provide consistent supervision to check application and effectiveness of treatment.

A NALCO SERVICE

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario, Canada

THE *Nalco* SYSTEM • Serving Industry through Practical Applied Science

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

PIPING AND VALVES

101 **Piping Pointers**—This is a new 36-pp edition of company's highly popular piping manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains many illustrated how-to-do-it features. Included with manual is an 8-pp valve selection guide to aid in selecting valves for common piping services. (Company also offers showings of a 30-min 16 mm film for use with manual in training beginners and refreshing veterans in industrial piping crews. Information about this film is available to power engineers who request it.) Crane Co.

102 **Piping Fabrication and Erection**—To demonstrate manufacturer's experience and facilities for fabrication and erection of industrial piping, 24-pp Bulletin 1700 presents a pictorial review of piping installations in steel mills, for gas transmission system, central power stations, water pumping stations, heating plants, oiler refineries and chemical process plants. Dravo Corp.

103 **Piping Layout Manual**—"Practical Layouts 36-50" is a 36-pp collection of basic piping layouts, with valve recommendations, covering a wide range of industrial set-ups—an automatic sprinkler system tank connection, oil burner piping for light oils, central pumping station for transfer of fluids, etc. Design fundamentals and applications of company's valves are also explained, illustrated. Jenkins Bros.

104 **Valve Specialties**—Included in 96-pp Catalog A-50 is complete ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves, pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Technical data includes capacity charts. Davis Regulator Co.

105 **Needle Valves**—Bulletin 51-N, 4 pp, describes and illustrates forged steel union bonnet needle valves of carbon or stainless steels for use on high pressure and corrosive services. Stresses construction features; includes operating data, list prices. Kerotest Mfg. Co.

106 **Power Operated Valves**—Providing excellent information on pneumatic-hydraulic and electric power operated valves, 44-pp Bulletin V-214 tells the advantages of using power operated valves and explains how manufacturer's valve design is especially applicable to power operation. Illustrated engineering data is provided on five types of operators—non-automatic, automatic and lever cylinders, and electric and pneumatic motor operators—covering installation, mounting, control equipment required. Also includes chapter on automatic lubrication of these valves by means of company's Hypermatic lubricant. Rockwell Mfg. Co.

107 **Revolving Joints**—Illustrated Catalog 300, 8 pp, presents rotary seals designed for steam or cold water service generally in excess of 25 to 50 rpm and up to 2500 rpm in some models. Design features described are illustrated by cutaway drawing. Full specifications and dimensions included, also tips on installation and lubrication. Repair parts for revolving joints are also listed. Barco Mfg. Co.

108 **Expansion Joints**—Illustrated Bulletin 351, 4 pp, on expansion joints and flexible connectors, gives sizes, dimensions, suggested applications and other technical data on a variety of joints from small flexible connectors for use on diesel exhaust lines to 30-ft dia self-equalizing joints. Zallea Brothers.

PUMPS AND COMPRESSORS

109 **General Purpose Pumps**—Bulletin B-2300, 24 pp, covers a line of economical, horizontal end-suction centrifugal pumps for a wide range of services. These pumps are driven by electric motor, come in ¼ to 150 hp sizes affording capacities of 10 to 5500 gpm. Two general types are presented—a close-coupled pump and a bracket mounted pump for driving through coupling, V-belt or flat belt pulley. Construction details, capacity information given. Includes selection chart, useful pump data. Peerless Pump Div., Food Machinery and Chemical Corp.

110 **Split Case Centrifugal Pump**—Latest developments in manufacturer's line of single-stage, split-case centrifugal pumps are covered in Bulletin 5004-A, 8 pp. Pumps shown are furnished for direct connection to electric motors, steam turbine, gasoline engines, or for use with belt drive. A performance table simplifies selection of unit to meet specific requirements for capacity and head, capacities ranging from 25 to 4000 gpm, total heads from 20 to 300 ft. Illustrations of construction elements, detailed specifications, dimension tables included. The Deming Co.

111 **Centrifugal Compressors** — Illustrated Bulletin 126-A provides 12 pp of detailed information on application of manufacturer's Turbo-Compressors to oil and gas fired equipment used in heat treating, agitation, cooling, drying, gas boosters and pneumatic tube systems. Performance curves, tables of capacities for both vacuum and pressure applications are included. The Spencer Turbine Co.

112 **Multi-Stage Compressors**—Featured in 36-pp Bulletin 116 is a presentation of engineering data and performance characteristics to enable power engineers to approximate power requirements, rotative speed and discharge temperature for most multi-stage centrifugal compressor applications. Also discusses general features of these centrifugal compressors and describes models covering capacities of 1000 to 65,000 cfm. Some specific applications

---

Use this CARD for information on ADS and NEW PRODUCTS also

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P. L. & R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING

110 South Dearborn

CHICAGO 3, ILLINOIS

PLEASE PRINT OR TYPEWRITE

June, 1951
Card Void in 6 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

_____

_____

_____

_____

_____

Your Name_____

Your Title_____

Your Company Name_____

Company Address_____

City_____ State_____

(If you prefer delivery at your home also fill below)

Home Address_____

City_____ State_____

Also, use this card for more information on advertised products.

are listed. Cutaway drawing and photos illustrate design and construction details and six typical installations are pictured. Clark Bros. Co., Inc.

113 **Vacuum Calculator**—Now available without charge to power engineers is a slide rule for quick vacuum calculations. It determines needed pump capacity to evacuate a given volume to a specified vacuum in a given time, and time required to reach a specified vacuum in a given volume with a pump whose capacity is known. Also determines vapor pressures of water at various temperatures and capacities of round tanks in both cubic feet and gallons per foot. On reverse side of rule are conversion tables including a Centigrade-Fahrenheit graph and chart showing boiling points of solvents under pressure. F. J. Stokes Machine Co.

WATER CONDITIONING

114 **Organics in Water Treatment**—Here's an interesting 4-pp folder describing the need for organics in altering the nature of sludge in order to make it non-adherent. Covers theoretical and practical considerations involved in use of organics; describes and illustrates manner in which they overcome sludge. Power Chemicals Div., E. F. Drew & Co., Inc.

115 **pH Explained**—"The Meaning, Application and Measurement of pH" is the title of Bulletin 28X7636, a 2-pp informational leaflet. Non-technical, it contains tables showing different pH values of common acids and alkalies, the intensity of acidity or alkalinity, and the most desirable pH range of industrial waters for different conditions and applications. Allis-Chalmers Mfg. Co.

116 **Zeolite Water Softeners**—Publication 4630, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and its relation to sodium zeolite softening process. Bulletin not only provides an exhaustive explanation of the new process but of the zeolites themselves and details of equipment used in the process. Cochrane Corp.

INSTRUMENTS AND CONTROLS

117 **Combustion Safeguard Manual**—Catalog 9901, 32 pp, is actually a complete handbook on flame failure protection for industrial applications. Includes information on new "flame-rectification principle" of operation, descriptions of many types of system components, installation drawings, bills of material, comprehensive information on 24 safeguard systems. Current price list is enclosed. Industrial Div., Minneapolis-Honeywell Regulator Co.

118 **Visual Smoke Indicator**—Four-pp Bulletin 5101 illustrates a wide angle smoke periscope, discussing the operation and installation of the instrument and picturing its use. Describes light and reflector units and vision box. Also describes a furnace indicator for viewing furnace performance from any point in boiler room. Ess Instrument Co. Ess Specialty Corp.

119 **Fuel Anticipator**—Bulletin CL-1, 2 pp, describes and illustrates company's Capacitline, a low-cost supplementary control device which anticipates fuel needs of controlled heating equipment, automatically reducing to a minimum the on and off variation of a control instrument above and below preset control point. Discusses simplicity, economy and other benefits; gives specifications. Wheelco Instruments Co.

120 **Polarized Field Frequency Controls**—This 8-pp bulletin illustrates and describes in detail standard types of polarized field frequency control for synchronous motors for full-voltage, reduced-voltage and part-winding starting. Includes ratings, weights, dimensional drawings, wiring diagrams, layout drawings and specifications. The Electric Machinery Mfg. Co.

121 **Smoke Alarm**—Single-sheet Bulletin 100 describes and illustrates an indicating, visual and audible smoke alarm which can be set to warn operator when density of gases in boiler breeching exceeds desired value. Explains operation of the alarm, tells how to install it, lists equipment. General Power Plant Corp.

122 **Boiler Feed Water Control**—Bulletin 489 is a 16-pp illustrated report on equipment and procedure utilized in control of boiler feed water at three plants of a southern power company. These plants feature three-influence control through hydraulic couplings of boiler feed pumps; conventional three-influence control using a feed control valve, and two-element air-operated control. Significant data on boilers used at these plants included. Northern Equipment Div., Continental Foundry & Machine Co.

123 **Contact Controls**—Form 5116, 24 pp, is a catalog on company's contact controls incorporating a double-action contact switch. Covers thermostats, time switches, warm air controls, hot water controls, pressure, vacuum and vapor controls, relays, stoker and oil burner primary controls, gas controls, other equipment and parts. Includes specifications, ratings. Perfex Corp.

ELECTRICAL AND LIGHTING

124 **Synchronous Generators** — Bulletin 05B7549 is a 32-pp illustrated presentation of hydraulic turbine driven synchronous generators and large vertical motors. Compares suspended and umbrella types of vertical generators, describing construction standards and details of stator, rotor, bearing and bearing housing. Shows advantages of enclosed construction using air-to-water heat exchangers. Also describes horizontal generators and modifications that can be incorporated into design of hydraulic turbine generators. Large vertical motors are briefly discussed, as is a combined motor-generator unit that can be used alternately as a hydraulic turbine-generator and a motor-driven pump. Allis-Chalmers Mfg. Co.

125 **Selector Switches** — Illustrated Folder EU2 (2) offers 2 pp of data on one- to six-pole, 12-position switches, totally enclosed and designed for low contact resistance and high stability. Discusses electrical performance, mechanical features, available combinations. Includes specifications, dimensions, electrical characteristics. Leeds & Northrup Co.

126 **Catalog on Potheads**—Bulletin AB-51, 72 pp, provides a complete listing of all capnut, disconnecting, and straight-through potheads. Gives directions for installation of potheads, and lists all pothead parts. Single-conductor potheads and 16 standard shapes of multiple conductor potheads are listed in ratings from 600 to 34,500 v. Fully illustrated, this informative catalog describes for the first time a rubber bushing stuffing box for leaded and non-leaded cables. G & W Electric Specialty Co.

127 **Indent-Type Electrical Connectors**—Hydent Catalog Y33, 28 pp, describes company's line of solderless electrical connectors and installation tools for industrial and manufacturing use. Gives full instructions for selecting them, according to a simple tool index system developed for ordering tools and components. Index shows which tools can be used for installing each connector size and prints for dies for tool selected. Advantages of indenting are detailed. Burndy Engineering Co., Inc.

128 **Testing Instruments**—Three low cost Megger electrical resistance testers are described in 8-pp illustrated Bulletin 21-85-25. Covers a midget insulation test-

(Continued on page 130)

Use this CARD for information on ADS and NEW PRODUCTS also

PLEASE PRINT OR TYPEWRITE

June, 1951
Card Void in 6 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

_____
_____
_____
_____
_____
_____

Your Name_____

Your Title_____

Your Company Name_____

Company Address_____

City_____ State_____

(If you prefer delivery at your home also fill below)

Home Address_____

City_____ State_____

Also, use this card for more information on advertised products.

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P. L. & R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING

110 South Dearborn

CHICAGO 3, ILLINOIS

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

A Power Company asked: "Can you help us stop tube failures?"

Dowell Service provided a fast, effective solution!

A midwestern power and light company, operating 350,000 lb. per hour steam generators, was having numerous unscheduled shutdowns because of tube failures. Although tubes were turbined periodically and inspections showed that deposits were small in amount, tubes continued to blister. A crisis was reached when 11 outages occurred in 18 days!

Dowell Service provided the answer with a *more effective, faster and more economical* method of maintenance cleaning. Tube failures at this power house have been practically eliminated. A regular cleaning schedule using Dowell Service has solved similar problems in many other plants.

What is Dowell Service? Experienced engineers fill the equipment to be cleaned with special liquid solvents designed to dissolve and disintegrate the profit-stealing deposits from all surfaces, even the most complex, *in a few hours*. The solvents are carried to the job in Dowell pump trucks and are pumped into the unit through regular connections. There is no dismantling.

Call Dowell for consultation on your cleaning problems. A Dowell engineer is as near as your telephone. No obligation, of course.

Other recent Dowell jobs:

Anthracite filters cleaned by Dowell Service in one working day. Backwash rate increased from 75 to 385 g.p.m.

★

Five air conditioning compressors cleaned for office building in 8 hours by Dowell Service. Result: $15.70 per day saved on power demand.

★

Two 40,000 lb./hr. boilers cleaned for paper company in 24 hours. Result: 37 tons of fuel per day saved under same load conditions.

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

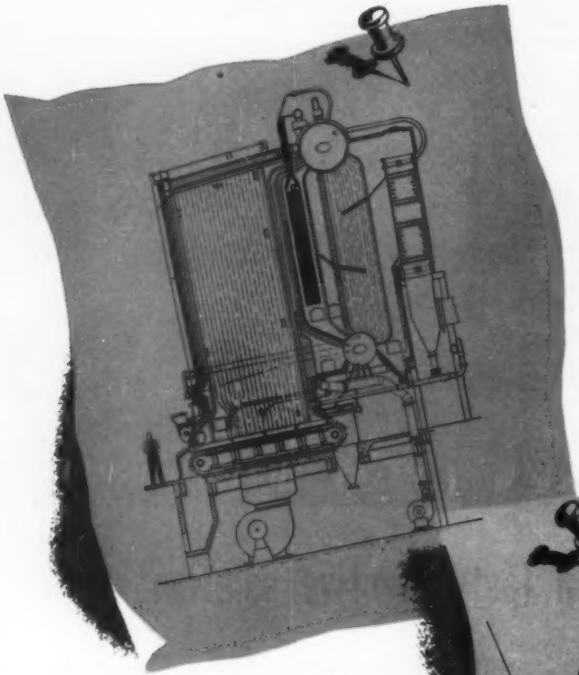
SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York 20	Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.
Boston 16	Cleveland 13	Wichita 2	Hamilton, Ohio
Philadelphia 2	Pittsburgh 19	Oklahoma City 2	Charleston 27, W. Va.
Baltimore 18	Detroit 2	Houston 2	Salem, Illinois
Wilmington 99	Chicago 2	New Orleans 12	Borger, Texas
Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
Jacksonville	Indianapolis	Shreveport 69	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

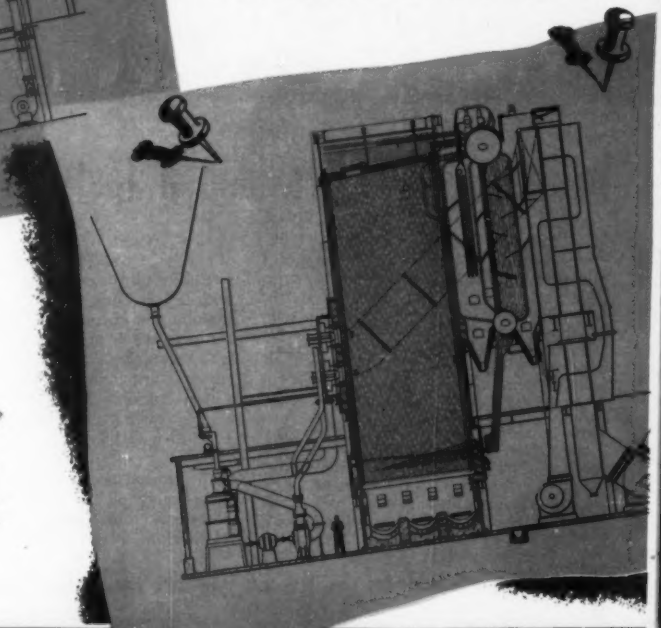
They keep coming



Companies that have bought VU Boilers *continue to buy them.* In fact, a substantial proportion of all VU Units, in service and on order, have been purchased by organizations whose selection reflects their own first-hand experience. *For example* —

A STEEL COMPANY now has a total of eleven VU Boilers in four different plants. Starting with three units in 1936, it has reordered three times... most recently in the fall of last year with an order for three more units.

A TEXTILE MANUFACTURER ordered two VU Units in 1936. Another unit was installed in 1940 and a third in 1944. Still another



VU-50 Unit fired with C-E Spreader Stoker (continuous discharge type). The capacity of unit shown is 80,000 lb steam per hr; operating pressure 425 psi steam temperature 650 F.

VU-50 Unit fired with pulverized coal. The capacity of unit shown is 200,000 lb of steam per hr; operating pressure 560 psi; steam temperature 760 F (VU units are in service for capacities up to 350,000 lb of steam per hr).

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

back for more!

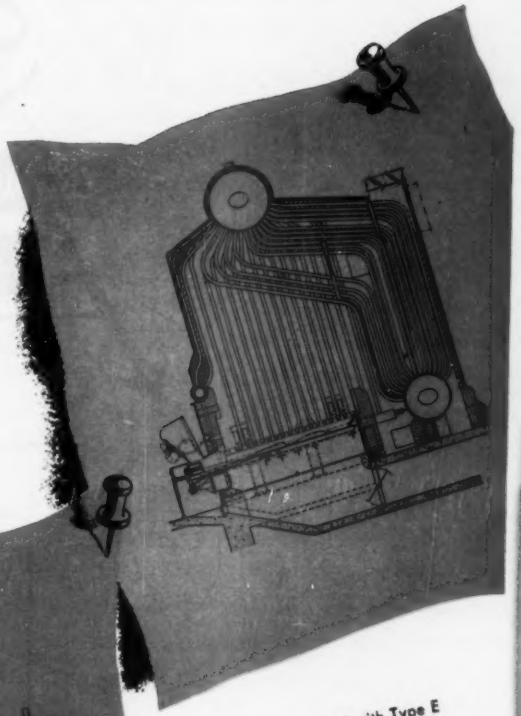
textile company installed one unit in 1945, a second in 1949 and has just ordered another.

A REFINING COMPANY ordered one VU Unit in 1937, another in 1940 and another in 1949 for one of its plants; also two in 1942 and one in 1947 for another plant.

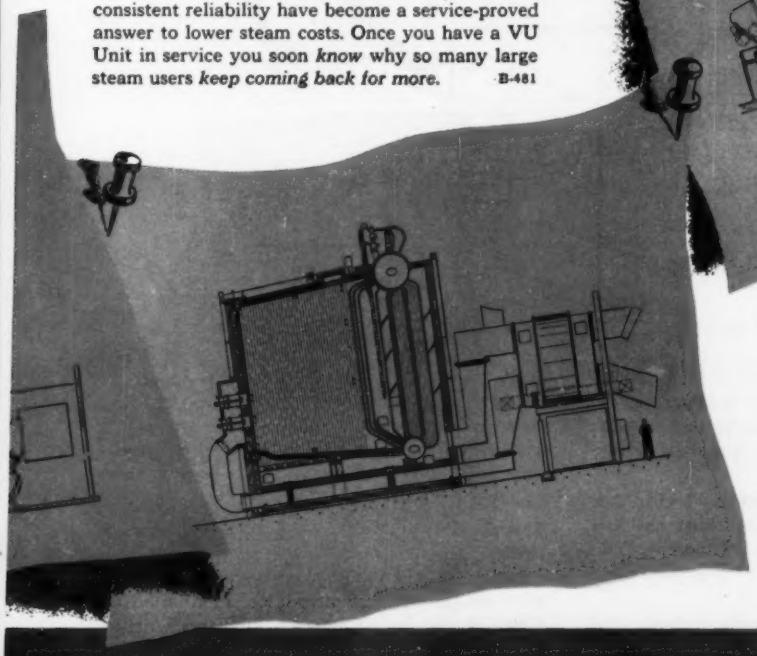
A SEWAGE TREATMENT PLANT in one of America's large cities is another consistent buyer of VU Boilers. Its initial order in 1936 was for two units. Since then it has reordered three times, and now has a total of seven VU Boilers in service.

• • •

The story is the same wherever you go — in all sections of the country American industry is ordering and *reordering* VU Units. Why? Because the VU's advanced design, sound construction and consistent reliability have become a service-proved answer to lower steam costs. Once you have a VU Unit in service you soon *know* why so many large steam users *keep coming back for more.* B-481



VU-10 Unit fired with Type E Stoker. VU-10 Boilers range in capacity from 10,000 to 60,000 lb steam per hr. They may be fired by spreader, underfeed or traveling grate stokers, or by oil or gas.



VU-50 Unit fired with oil or gas. The capacity of unit shown is 175,000 lb of steam per hr; operating pressure 400 psi; no superheat.

— SUPERHEATER, INC.

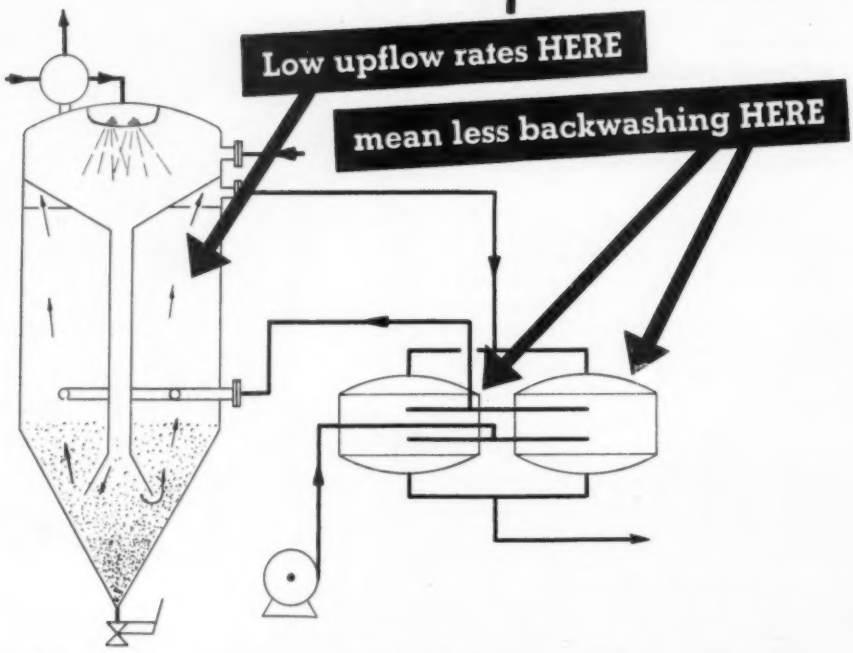
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

Why GRAVER

HOT PROCESS SOFTENER FILTERS

Stay Cleaner



Among the many distinctive features of the GRAVER Hot Process Softener is the *low rising rate* of the treated water to the discharge after the softened water has passed through a dense bed of previously precipitated solids.

Compared to other hot process softeners, the GRAVER design provides as low as *half* the rising rate in a softener tank of given diameter and capacity. This means more efficient separation of precipitates and clearer treated water.

Therefore, the GRAVER Hot Process Softener is an effective *clarifier* as well as softener. It imposes less load on the filters . . . the filters stay clean longer . . . far fewer filter backwashings are needed . . . filter maintenance time and expense are greatly reduced . . . and in some instances, such as where a hot zeolite softener is used for second-stage treatment, filters may be unnecessary.

This principle of *more complete removal of precipitated solids within the softener tank* is one of many examples of GRAVER pioneering in water softener designs. For complete information on *all* the GRAVER Hot Process Softener advantages, write for Bulletin WC 102.

OW-427

GRAVER

GRAVER WATER CONDITIONING CO.

216 West 14th Street, New York 11, New York, U. S. A.

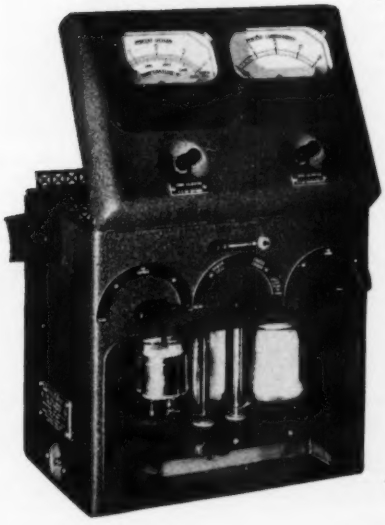
A DIVISION OF GRAVER TANK & MFG. CO. INC. EAST CHICAGO, IND.

Mobilizing BTU's

Now that the "heat's on" for record production, the calls are increasing for the services of the Cities Service Heat Prover. This scientific instrument gives an accurate, instantaneous and continuous picture of combustion conditions in all types of furnaces.

You'll readily be able to calculate any oxygen excess, waste combustible matter, and potential fuel savings. The results are like an accurate "diagram" of corrective measures needed to conserve heat units for consistently higher production at lower cost.

You'll see profit in applying the Cities Service Heat Prover . . . *not an instrument you buy, but a service we supply!* Call or write your local Cities Service office about arrangements. Or simply return the coupon today.



THE COMPLETE CITIES SERVICE LINE FOR THE METAL FABRICATING INDUSTRY INCLUDES

Chillo Cutting Oils • Trojan Greases • Trojan Gear Oils
Pacemaker T Hydraulic Oils • Optimus Cylinder Oils
Q-T (Quenching and Tempering) Oils

CITIES SERVICE OIL CO.
Sixty Wall Tower, Room 992
New York 5, N. Y.

Without obligation please send your booklet, "Combustion Control for Industry."

Name_____
Company_____
Address_____
City and State_____

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

NEW EQUIPMENT NEWS

WHAT'S NEW? On these pages the Editors summarize the outstanding industrial developments of leading manufacturers who will supply you, free of charge, the bulletins or other information desired. For ease in making requests use the no-obligation, postage-paid card pages 45-46.

1—REFRACTORY COATING

Comes in liquid form, is easily applied and dries to a hard finish

This coating is said to dry to a diamond-hard finish, which practically becomes an integral part of the brick, expanding and contracting uniformly with the brick under various heat conditions. It will not crack off or flake, company reports, and tests show that it will prevent slagging, spalling, abrasion and disintegration of fire bricks caused by chemicals and high temperatures.

Among other advantages noted are the greater reflection of heat resulting from its smooth, hard surface; greater protection and longer life of fire bricks. Coating may be brushed on or sprayed and boiler fired immediately after application, company adds. Power Chemicals Div., E. F. Drew & Co., Inc.

2—SINGLE-PHASE REGULATORS

Feature 33 per cent reduction in floor area, weight and oil

Single-phase regulators in the redesigned Type URS are smaller and lighter in weight than previous design and have a cover welded on in a manner similar to larger transformers. New features in the tap changer include spur gear reduction, use of company's DynAC brake, and a control cabinet integral with tap changer. The control panel is standard, with Flexitest relays, AB breakers, test terminals and separate resistance and reactance elements for 24 v compensation. The selector switch is identical to the URS three-phase design rated at 400 amp with 15 kva insulation.

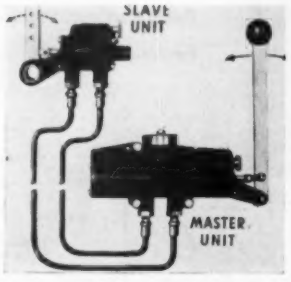
These regulators are used primarily to automatically maintain desired voltage levels on single-phase distribution feeders and where it is desirable to separately regulate various phases of a three-phase feeder because of widely divergent loads on one phase as compared to another. Westinghouse Electric Corp.

3—REMOTE CONTROL SYSTEM

Hydraulically operated, is self-contained, needs no power source

Master and slave units of this remote control system are interconnected by two small tubes. Motion applied to actuating lever of the master unit is duplicated by the slave unit lever; it has load carrying ability in both directions. The system is designed to provide for expansion and contraction of both fluid and metal due to temperature changes in a manner that assures synchronization between the two units, and an automatic lock in the slave lever provides irreversibility. Company says either unit may be mounted stationary or movable in any position.

Designed to handle 500 in.-lb of torque, this compact control system



is suggested for manipulation of throttles and other controls. Typical applications include power plants, processing machinery, machine tools. Superdraulic Corp.

4—MECHANICAL SHAFT SEAL

For high temperature, corrosive conditions; has Teflon sealing member

Instead of the leather or synthetic rubber member used in many flexible mechanical seals, the new Type 9 incorporates a flexible ring molded from Teflon. This plastic wedge-ring is used to give the seal the chemically inert properties of Teflon with the flexibility and positive sealing components needed for good mechanical sealing. It can be used at temperatures to 500 F, company says, and is designed for service on rotating shaft applications, such as centrifugal pumps, turbines, positive displacement pumps and agitators. Crane Packing Co.

5—MASTER REGULATOR

Is designed to save fuel by holding steam pressure at desired level

For use wherever it is necessary or desirable to hold steam pressure at a certain prescribed level, the Model SC-B is described as especially applicable for process steam production where constant pressure must be maintained despite varying load demands. It is designed to regulate steam pressure automatically on any type of stoker-, gas- or oil-fired boiler and, when installed with company's Lectricarm drive unit, to provide automatic modulation of fuel and air supply in direct proportion to pressure changes.

The pressure controlling unit consists of bellows, floating contacts, compensating motor and a pressure adjusting mechanism. This steam control saves fuel in three ways, company states, by eliminating over-firing, by modulating fuel and air supply to correct ratio for maintaining combustion efficiency, and by eliminating "start and stop" firing. Standard units of the Model SC-B are available for 110 or 220 v 60 cycle current, and for a wide selection of pressure range requirements. Cleveland Fuel Equipment Co.

6—ELECTRIC SOLENOID

Comes in medium size range, but with power for larger size applications

Available in three voltage ranges—110, 220 and 440 — with $\frac{5}{8}$ in. maximum stroke and rated pull or push ranging from 4 to 10 lb against gravity, this new

solenoid is dimensionally interchangeable with standard solenoids. Features announced include simplified construction enabling disassembly for coil replacement without removing solenoid from original mounting, and fan-proof laminations. A T-shaped armature is said to provide an unusually high rating with half the impact when energized while producing a closed magnetic circuit devoid of air gaps. Low temperature operation is credited to the small coil current required when closed. Practical Electric Co.

7—FORGED STEEL GAGE VALVE

In $\frac{1}{2}$ in. size, is now available with male inlet and female outlet

Except for the male inlet this is the same as company's gage valves with female connections on both ends. The new valve requires no nipples, because the male inlet basically serves the same purpose, and since it is an integral part of the forged steel valve body it offers greater strength. The wall thickness of the male inlet is extra heavy to provide more protection against breaking off or rupturing.

The over-all compactness of this gage valve makes it especially adaptable for use in cramped areas. It also features a safety taper threaded joint between

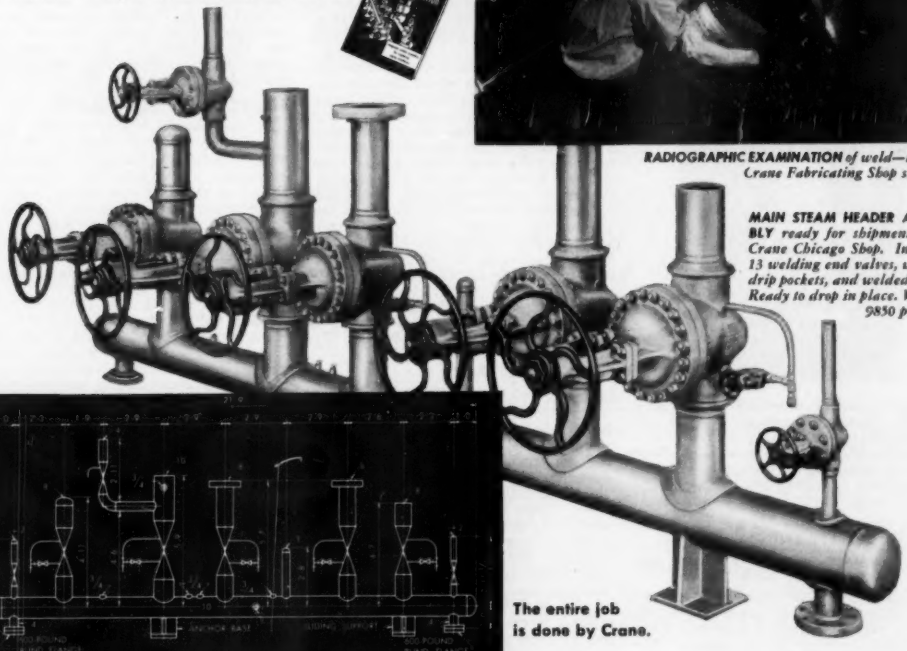
no unit fabrication job too tough for CRANE

Whether your piping project calls for a simple pipe bend . . . or a complex welded assembly . . . Crane fabricating facilities can handle it. No pipe shop is better equipped to do your *entire* job from drawings of *your* design.

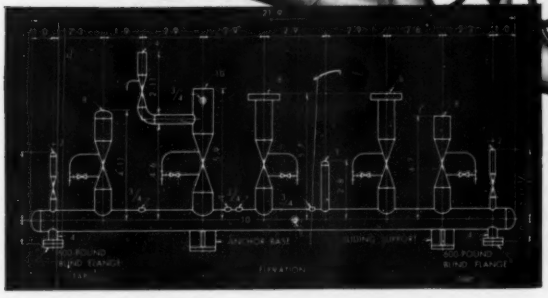
At Crane all steps of fabrication—such as bending, welding, stress relieving or heat-treating, radiographic examination, hydrostatic testing—are rigidly checked under procedure control to maintain adequate standards of accuracy and quality.

And because each assembly is tested as a unit, with major assemblies proved in advance of installation—you can erect your piping systems with minimum expense and delay. For further information, **ask for Folder AD-1771.**

RADIOGRAPHIC EXAMINATION *of weld—typical Crane Fabricating Shop service.*



MAIN STEAM HEADER ASSEMBLY *ready for shipment from Crane Chicago Shop. Includes 13 welding end valves, welded drip pockets, and welded bases. Ready to drop in place. Weight 9850 pounds.*



The entire job is done by Crane.

CRANE

CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

body and bonnet to prevent bonnet from backing out of the valve. The valve comes in two styles: angle, Fig. 153J; globe, 152J. Edward Valves, Inc.

8—CONTROL DEVICE

"Anticipates" the fuel needs of controlled heating equipment

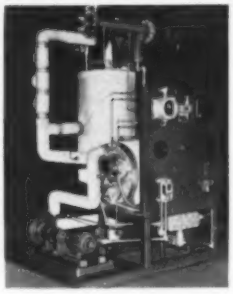
The new Capaciline is a simple, low-cost supplementary control device. By anticipating the heat transfer lags it automatically reduces to a minimum the on-off variations of a control instrument above and below the preset control point, to enforce a straight line control on the heating variables.

It may be used to add the equivalent of proportioning control to any heating equipment with conventional "on-off" control, according to manufacturer, and when used over ovens, furnaces, kilns and vats means a saving of fuel, elimination of spoilage, and continuous uniform production. The Capaciline is operated through a simple electrical circuit and is available as a self-contained unit or built into company's electronic controllers and strip chart recorders. Wheelco Instruments Co.

9—HEAT TRANSFER UNITS

Electrically heated, Dowtherm type, are shipped ready for use

Supplied complete with instruments, piping, insulation and accessories, these units have capacities of 100,000 to 500,000 Btu per hour. They have a temperature range to about 750 F using Dowtherm as a liquid or vapor medium. Other heat transfer fluids may be used.



The entire unit may be base mounted at the factory or supplied with all equipment for mounting at the plant. Equipment includes a special heating element designed to eliminate thermal breakdown or coking trouble. Struthers Wells Corp.

10—DIESEL ENGINES

For continuous duty stationary generating service; totally enclosed

Two new lines of diesel engines are announced by this manufacturer as offering compactness and freedrom from vibration event at critical speeds. The EV Series, built to Lloyd's specifications, includes two-, three-, four-, six-, and eight-cylinder models developing 90 to 360 hp at 600 rpm. The turbocharged EVS Series is offered in four-, six- and eight-cylinder sizes rated 240 to 480 hp at the same speed. All models have bore and stroke dimensions of 8¾ by 11½ in.

Although enclosed, these engines have access to working parts through large, non-resonant doors on both sides of frame. They are designed for constant or varying load, sustained service in industrial and municipal lighting and power service, pumping stations. Lister-Blackstone, Inc.

11—REVERSE ACTION RELAY

Incorporates bronze case, top and non-wearing parts

Ratio plates, inner valves and seats of the Type 228 Reverse Action Relay are of stainless steel with diaphragms of nylon inserted neoprene. The relay is designed for delivering maximum pressure output at minimum pressure input from pilot or other controlling source, or vice versa, without any modification in either pilot or valve hookup. Manufacturer points out that reversal of valve closure in relation to pilot action is required from time to time, installation of this relay in a by-pass line will provide a simple, fast and inexpensive method of making the change. Black, Sivalls & Bryson, Inc.

12—IRON PULLEYS

For supporting loads to 200 lb, feature increased corrosion resistance

Designed for intermittent service in a wide range of applications the pulleys in this new line can be utilized with cable, chain or rope from ⅛ to ½ in. dia, and are suggested for use with elevator doors, remote control liquid level indicators, fire door counter-weights, and other types of chain or rope operated equipment.

They're made with a deeply grooved, molded composition wheel that has excellent resistance to wear, acids, alkalies, oils and corrosive gases, according to manufacturer, and their malleable iron housing closely shroud the wheels to prevent the cable, chain or rope from slipping between wheel and housing. Bronze axles are used, and lubrication is declared unnecessary because the composition wheels are impregnated with graphite on the axle bearing surfaces. Two coats of baked enamel on housing provide extra corrosion resistance. Standard pulley types include corner, through overhung and under models. Hinged and swing-type units available. The Thompson Electric Co.

13—SERVICE TAP

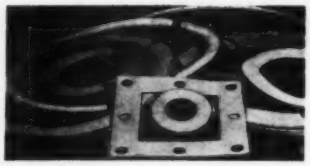
Of cast copper alloy for heavy duty service connections

Intended for both inside and outside use, this husky, compact tap has casting designed to swivel to permit easy insertion of conductors. The construction is such that it keeps tap assembled when clamp is open, and serrations on both body and cap prevent cables from working loose after tap is installed, company says. Conductors are forced into high pressure contact by two standard hex head cap screws. This tap is also said to be excellent for dead-ending wires. Smooth, rounded edges permit easy taping. Comes in sizes 2 to 1000 Mcm (main), 10 to 1000 Mcm (tap). O. Z. Electrical Mfg. Co., Inc.

14—ASBESTOS GASKETS

For use on manholes and handholes in a wide range of equipment

Pars Asbestos Gaskets are said to give exceptional service where surfaces are rough or uneven and subject to considerable expansion and contraction. These gaskets are used to hold steam,



air, water, ammonia, other alkali chemicals and acids in storage tanks, dryers, laundry machinery, boilers. On standard sizes flanges are 3/16 in. thick and 7/16 in. wide or larger, inside diameters are 2½ to 18 in. Larger sizes and irregular shapes may be ordered. Lawton H. Parsons.

15—PILOT LIGHT

Features low cost and low power consumption, wide range of models

The improved Omni-Glow Model 1010 is a neon light encased in a nylon tube which slips through the mounting panel and is held in place with a speed nut. The Fresnel lens comes in a wide range of colors suitable to neon and a polished metal collar connecting lens and body trims the operating side of the panel.

Operating on a high voltage range from 75 to 250 v a-c or d-c, the standard model gives a soft light with little heat. Company points out that the neon light withstands vibration and shock, as well as overloads, that would damage many pilot lights. Standard unit has 4½ in. leads, ½ in. stripped and tinned for easy electrical hookup. Industrial Devices, Inc.

16—VOLTAGE REGULATOR

Is low-cost, single-step type, suggested for rural distribution lines

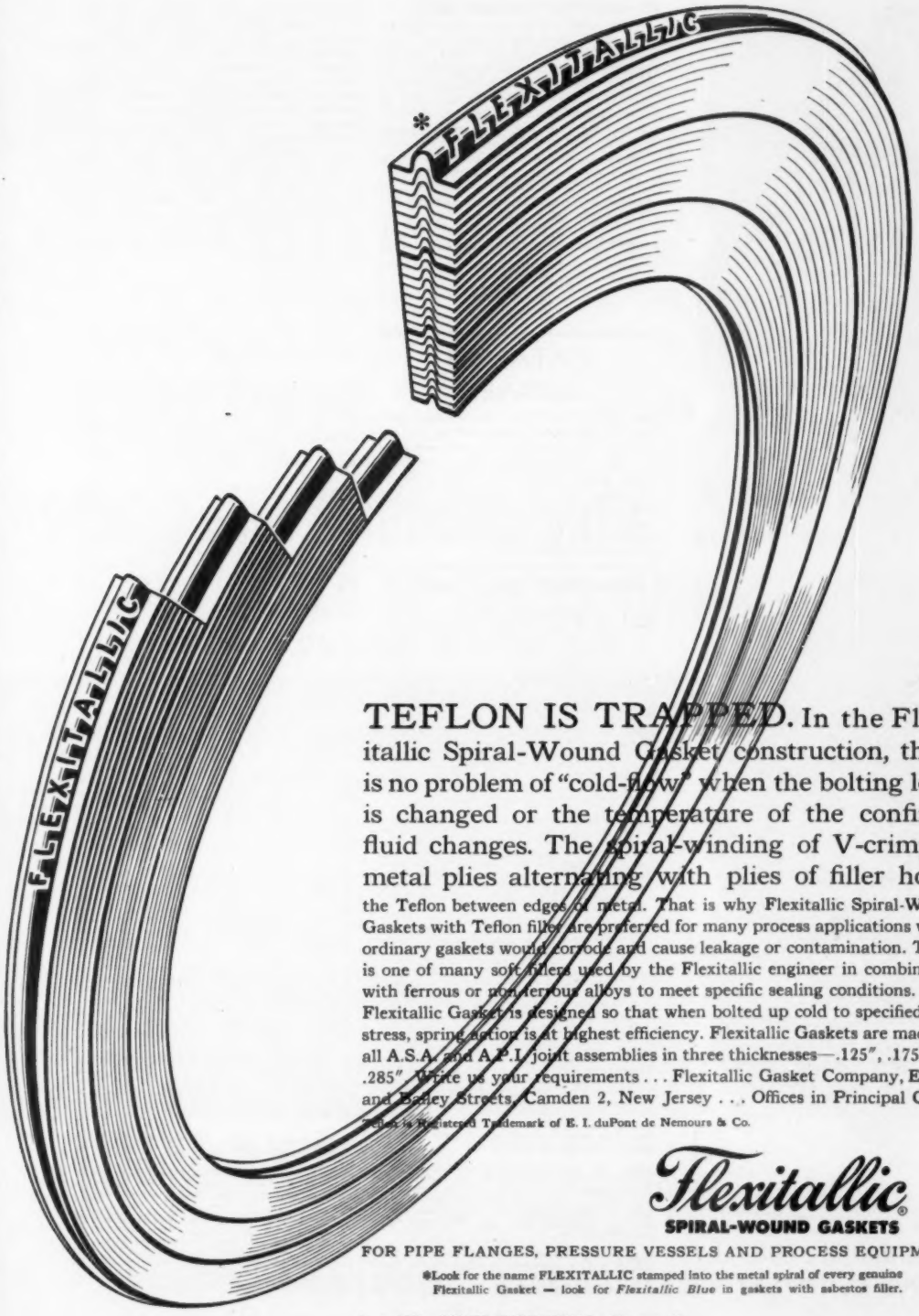
This regulator is designed to reduce customer complaints on overloaded lines and stave off immediate need for recoppering and rephasing, company points out. It is said to be particularly adapted to rural distribution lines where it may be cascaded with minimum inter-reaction to bring voltage within tolerable limits, providing an economical and flexible means of correcting voltage drop as required.

Its features included light weight, few moving parts and quick-change subassemblies. It is controlled by an overdamped contact-making voltmeter, indicating as well as contact-making, and a time integrated delay built into its switching drive. It is pole mounted, O.I.S.C., 20 amp normal, 40 amp for 4-hr peak. On 7200 and 7620 v 60-cycle grounded systems it regulates 300 kva, single phase. Rural Transformer & Equipment Co.

17—RUBBER COMPOUND

For molded seals, performs well over extreme temperature range

O-rings and other precision molded seals may now be obtained in a new synthetic rubber compound, Parker 42, said to perform effectively in sealing performance in the temperature range from —85 to 275F. It is also described as resistant to non-fuel petroleum products, such as lubricating oils and hydraulic fluids, and satisfactory for service with ozone. Other physical characteristics given for the new formulation are tensile strength of 2000 psi, elongation 100 per cent, and permanent set 3 per cent. The Parker Appliance Co.



TEFLON IS TRAPPED. In the Flexitallic Spiral-Wound Gasket construction, there is no problem of "cold-flow" when the bolting load is changed or the temperature of the confined fluid changes. The spiral-winding of V-crimped metal plies alternating with plies of filler holds the Teflon between edges of metal. That is why Flexitallic Spiral-Wound Gaskets with Teflon fillers are preferred for many process applications where ordinary gaskets would corrode and cause leakage or contamination. Teflon is one of many soft fillers used by the Flexitallic engineer in combination with ferrous or non-ferrous alloys to meet specific sealing conditions. Each Flexitallic Gasket is designed so that when bolted up cold to specified stud stress, spring action is at highest efficiency. Flexitallic Gaskets are made for all A.S.A. and A.P.I. joint assemblies in three thicknesses—.125″, .175″ and .285″. Write us your requirements . . . Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey . . . Offices in Principal Cities.

Teflon is Registered Trademark of E. I. duPont de Nemours & Co.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Look for the name **FLEXITALLIC** stamped into the metal spiral of every genuine Flexitallic Gasket — look for *Flexitallic Blue* in gaskets with asbestos filler.

18—ONE-PIECE SEALING RING

Is made with sealing member located on the inner side of the ring

Described as a step-cut joint sealing ring, the Inseal is said to reduce wear on cylinder walls in equipment with little lubrication or temporary failures of lubrication. Since the sealing member is on the inside the new ring exposes only one material to the cylinder wall. This design also permits use of stronger materials—such as high tensile strength steel—for sealing members. Advantages credited to the inner-seal design are increased efficiency, lower fuel consumption, and elimination of damage by burning gases escaping through ring gap.

Because the inner sealing member extends full width of the ring, the Inseal has no "top" or "bottom," company explains; it seals from both sides and cannot be installed upside down. These features make it especially adaptable for use on single-groove, double-acting pistons in engines, compressors and pumps. Another feature, a semi-locking arrangement in which one ring end is restrained in its radial movement, makes the seal suitable for use in two-cycle engines. Company recommends it for use in two- and four-cycle gas and diesel engines, steam engines, air and gas compressors, pumps and hydraulic and pneumatic machines. Double Seal Ring Co.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

INSTRUMENTS AND CONTROLS

201 For Centralized Control—Bulletin 109, 4 pp, presents the new, compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve and remote manual relay. Bailey Meter Co.

202 Remote Reading Flow Meters—Data Book 702, 32 pp, fully illustrates and explains flow measurement problems and offers suggestions for their solution. Meter bodies, differential devices and reading instruments are fully described. Republic Flow Meters Co.

203 Flow Meters—Bulletin 400-F2, 8 pp, features company's meter for measurement of steam, air, or gas flow in 1 or 1½ in. pipe lines, and designed for installation directly in the line being metered. Illustrated with photos of meter, sectional and dimensional drawings, bulletin discusses meter's advantages. Builders-Providence, Inc.

204 Putting the Ratio Totalizer to Work—Twelve suggested applications of company's ratio totalizer in automatic control circuits are described and illustrated by diagram in 8-pp Bulletin 5450. This new device is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

205 For Practical Men—That's the title of this 24-pp pocket-size booklet presenting insulation testing in simple language. Packed with maintenance hints, it explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in terms of long run economy and prevention of shutdowns. James G. Biddle Co.

206 Air Locks—Bulletin S-31, 2 pp, describing company's air locks and trip master controls for holding regulating and control valves in position during failure of air supply, is illustrated with photos, diagrams and line drawings. The Swartwout Co.

207 Flow Tubes — Catalog 80, 4 pp, presents engineering data on a new primary element for measuring, regulating and controlling fluid flow. Tells how these flow tubes are designed and how they function and discusses their advantages. Foster Engineering Co.

208 Control equipment — General Catalog 001, 30 pp, is devoted to measuring and control equipment for water and sewage works, power and processing industries. Catalog illustrates and describes in detail: venturi tubes and meters, controllers, gages, manometers, pilot equipment. Simplex Valve and Meter Co.

209 Flow Controllers—Catalog 950, 4 pp, describes and illustrates differential pressure and variable area flow measurement instruments incorporating company's Magna-Clutch principle. Photos show how controllers are designed and operate, text covers low maintenance, flexibility, other advantages. Penn Industrial Instrument Corp.

BOILERS AND AUXILIARIES

210 Re-Circulation Steam Generator—Here's a 6-pp folder introducing a controlled re-circulation steam generator, describing its development and recommended uses, such as applications where steam is required in remote locations, where demands are intermittent or load fluctuating. Illustrated by cutaway drawing, text explains generator's operation, principal features. Combustion Engineering-Superheater, Inc.

211 Packaged Generators — Bulletin SB-38 introduces company's new Keystone model. Photos and sketches show complete unit, pressure element and details of its compact design. Gives advantages of two-drum water boiler, three-pass gas travel, automatic gas or oil burner. Dimensions, capacities. Erie City Iron Works.

212 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

213 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm in such a way as to provide dependable operation at maximum temperatures, discusses its advantages. The Wickes Boiler Co.

214 Tube Expanders—Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators other equipment. Thomas C. Wilson, Inc.

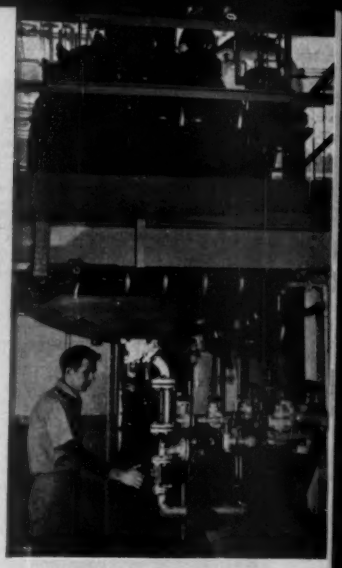
215 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Also includes data on motors, hose. Roto Div., Elliott Co.

216 Streamlined Baffle Walls—Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernizing existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co.

Chas. Pfizer & Co., Inc., is the discoverer and sole manufacturer of terramycin, the newest "wonder drug," which has proved effective in the treatment of *more than 50 acute infections.* Pfizer is the world's largest producer of antibiotics and a leading producer of synthetic Vitamin A.

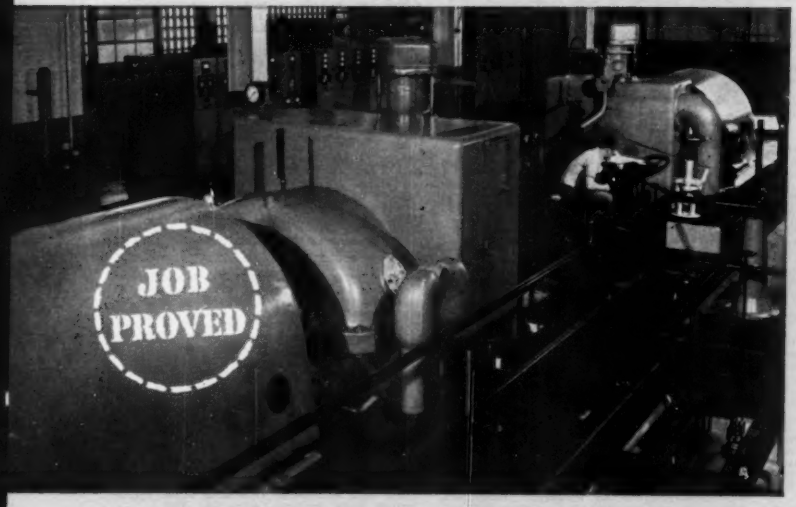
Power—lots of it and never failing—is needed by Pfizer's modern plant at Groton, Conn., to safeguard round-the-clock production. The plant relies entirely upon its two steam turbines for power, light, and refrigeration. For the utmost protection, "Job Proved" Sunvis 916 Oil was chosen as the lubricant for these turbines when installed—two years ago. This Sunvis 916 has been in continuous service ever since. As expected, inspections show the turbines free from rust, sludge, and corrosion; and laboratory tests show the oil ready for thousands of hours of continued service.

Sunvis 900 Series Oils are unsurpassed as turbine lubricants. Under normal operating conditions they will be *good for the life of your turbines.* For complete information, telephone the Sun Office nearest to you or write Department P-6.



THE EQUIPMENT pictured here is utilized in one of the stages of a complex process that Chas. Pfizer & Co., Inc., world's largest producer of antibiotics, follows in the manufacture of its new "wonder drug," terramycin.

POWER FOR "WONDER DRUG" PRODUCTION PROTECTED BY SUNVIS TURBINE OIL



TWO 2,500 KW TURBINES, each charged with 300 gallons of Sunvis 916 Oil, generate all of the plant's power. The condensing-extraction unit has been running over 15,000 hours, the back-pressure unit over 7,000 hours.

THE LUBRICATING OIL flows continuously through a layer of wool, then a tank of water, and finally a triple bag filter. Recent tests at Sun's laboratories show that the oil is in excellent condition, and good for thousands of hours more.

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO®

217 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. Several installations are illustrated. The Air Preheater Corp.

218 Soot Blower Head—Illustrated Bulletin 485, 4 pp, describes a new rotary soot blower head for improved boiler cleaning. Explains how blower head is designed to give maximum blowing pressure through the full blowing arc, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

WATER TREATING, CORROSION PREVENTION

219 Water Conditioning Information— Here are three informational bulletins of value to power engineers. No. 28X7446 describes a simple and accurate way to determine total hardness in water, illustrating procedure and explaining principle. No. 28X7559 gives an analysis of the hot process-hot zeolite system, telling results to be expected and advantages. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. All three bulletins available, list those wanted. Allis-Chalmers Mfg. Co.

220 Modern pH and Chlorine Control— This 100-pp booklet gives technical details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on the meaning of pH control, electrometric and colorimetric methods of determining pH and also determining impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

221 Water Softeners — Bulletin WC-102 is a 36-pp presentation of recent developments in hot-process water softeners. Explains boiler plant troubles caused by various impurities in water, outlines 12 methods of treating water to eliminate these impurities, describes reasons for the popularity of the hot-process method and its advantages, and explains the chemistry of hot-process water softening. Graver Water Conditioning Co.

222 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50, 4 pp. Procedures, reagents, and equipment are pictured and described. Bulletin tells how tests may be used to determine water hardness, hardness due to calcium alone and hardness due to magnesium alone. Hall Laboratories, Inc.

223 Boiler Water Treatment — Bulletin 47, 8 pp, is on internal treatment of boiler water. Defines internal treatment and tells its advantages in softening, sludge conditioning, stabilization. Explains operation of company's system, including the chemicals used. National Aluminate Corp.

224 Ion Exchange Systems — "Amberlite Monobed Deionization" is a 12-pp miniature textbook covering the history, behavior, present performance, and potential uses of the Monobed ion exchange systems in water-conditioning, chemical processing and other industries. Reactions of various combinations of exchangers are explained in text and equations. Also discussed are operating costs, equipment costs, quality of product derived, rinse requirements and other properties as they apply to the complete or partial single-step removal of ionized solids. The Resinous Products Div., Rohm & Haas Co.

225 Pocket Book on Chemicals — Here's a handy little 28-pp manual covering chemical products used by the power engineer. Most of those listed are water treating chemicals, but there's also a brine treatment, a fuel oil sludge dispersant, a soot remover, and protective coating. Tells what each product does and how and where to use it. Includes a helpful reference chart suggesting the application of these products. Western Chemical Co.

226 Boiler Water Manual—Factual information on standard methods of applying chemicals in the treatment of water for boilers is presented in this 16-pp technical bulletin, called Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feedwater system, condensate returns, flushing. %Proportioneers, Inc.%

227 Water Softening Equipment — How the problems caused by hard water can be offset by the use of water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. Illustrates a fully automatic softener. The Permutit Co.

228 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations to suit individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment and test control. Filled with illustrations, this helpful booklet also describes available equipment and includes a reference bibliography of literature on specific formulations. Dearborn Chemical Co.

229 Boiler Corrosion—A 12-pp article discussing the cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111 titled "Corrosion: Its Effect in Boiler Systems." The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity and physical factors are evaluated. W. H. & L. D. Betz.

230 Two-Stage Water Conditioner—Bulletin 4801 describes a water conditioner which combines advantages of both hot process and zeolite softening. Explains operation of softener in which first stage is the hot process using lime or Dolomitic lime and second stage the zeolite reduction of hardness. Cochrane Corp.

231 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a 4-pp folder covering amine treatment for inhibiting of boiler and condensate systems. This treatment is described as affording surface protection of the metal itself as well as raising the pH value of the condensate. Gives case histories and economies obtained by power plants using this treatment. The Bird-Archer Co.

232 Slurry Type Softener—Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. An excellent question-and-answer appraisal of system is included, and equipment is pictured. Worthington Pump and Machinery Corp.

ELECTRICAL

233 The Why of Dry Type Transformers —Booklet B-4428, 24 pp, discusses reasons why dry-type transformers are safer and less expensive to install and maintain in industrial plants and utilities. Types of air-cooled transformers for every use are illustrated from small ones for operation of intercommunication systems to power centers as large as 10,000 kva. Also describes sealed, submersible, dry-type transformers for installation underground. Westinghouse Electric Corp.

234 Power Factor Correction—Examples showing basic considerations in the improvement of system power factor are contained in Bulletin 05B7465, 4 pp. Points out economical and operational advantages of improving plant power factor and advisability of keeping the load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

235 Synchronous Motors — High speed synchronous motors are described in 4-pp bulletin PB 5600-B. The bulletin is packed with descriptive matter and photographs explaining features. Elliott Co.

236 Care of A-C Rotating Equipment— To promote intelligent and consistent maintenance of electrical machines, company has published Bulletin 05R7417, which is a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, and such subjects as drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

237 Buyers' Manual on Motors and Control—Fifty-pp Catalog GEC-1009 persents buying information on a carefully selected group of motors, motor starters, control accessories and electronic control. Ratings listed are those most frequently required. Excellent data on proper selection of this equipment is provided as well as full descriptions, dimensions, ratings, prices. Fully illustrated. General Electric Co.

VALVES, TRAPS, PIPING

238 Bonnet Valves—"Pressure-Seal" bonnet valves are described and illustrated in Form AD-1819. Includes sizes, dimensions, ratings and tests for gate, globe, angle and stop check valves for high pressure and high temperature service. Also explains operating advantages, tells how pressure seal is made. Crane Co.

239 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blower, water column blow-down, and other types of pipe line. Includes tables of dimensions, weights; list prices. Everlasting Valve Co.

240 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special construction features and other advantages. E. M. Dart Mfg. Co.

241 Blow-Off Valves—Illustrated Bulletin B-433, 24 pp, describes blow-off valves for high-pressure boilers, and covers seatless, hard-seat and unit-tandem types, for working steam pressures from 400 to 2500 lb. Construction details and operating principles are illustrated by cutaway drawings. Dimensions and specifications included. Yarnall-Waring Co.

242 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes—150 to 2500 lb—and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains special design features, gives construction details, dimensions, ratings, material specifications. Edward Valves, Inc.

243 Valves, Fittings and Flanges—Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides not only ordering information on company's complete line, but also much helpful engineering and application data, and includes a section on products for refrigeration service. Fully illustrated, well-indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

244 Automatic Valve Specialties — Company's pressure, flow, and liquid level controls for steam, air, gas, water, oil and other fluids are shown in 60-pp Condensed Catalog A-50. All equipment is described as to construction and application. Dimensions and prices are included. Technical data includes capacity charts and conversion tables. Davis Regulator Co.

245 Pressure Reducing Valves—Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are presented in 12-pp Bulletin 477-A. Also described is company's desuperheater. Northern Equipment Co.

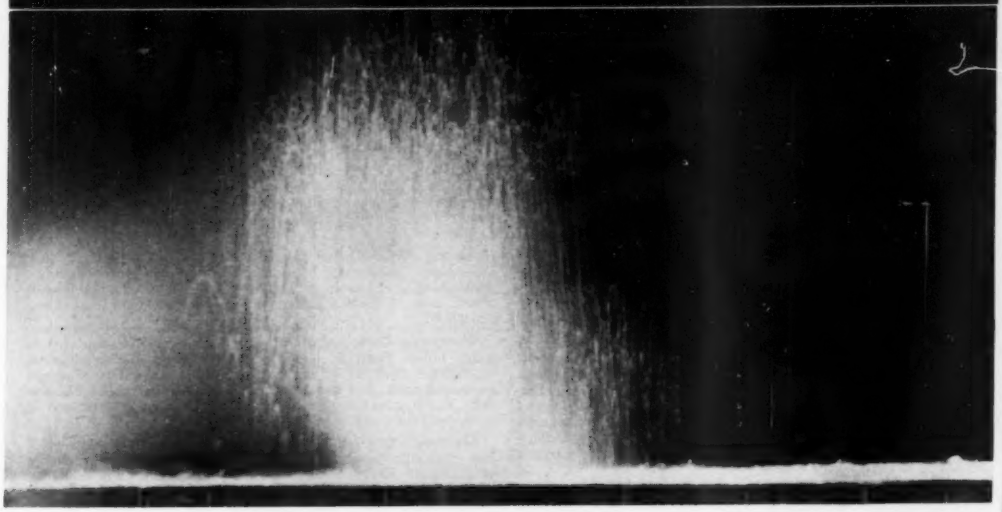
246 Steam Traps and Temperature Controls—Here is a comprehensive catalog comprising many of company's bulletins on steam traps and related equipment, including an illustrated steam trap selection chart. Provides data on boiler steam traps, air eliminators, thermostatic steam traps and air vents, inverted bucket steam traps, temperature regulators and cooling controls, steam and water mixers, thermostats and strainers. Contains sizes, application data, prices. Sarco Co., Inc.

247 Steam, Air, Gasoline Traps — This 32-pp illustrated catalog, No. 250, describes five types of thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air and gasoline service, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb, and also steam, air and gas separators. Includes capacity tables, installation diagrams. W. H. Nicholson & Co.

(Continued on page 134)

this is **aerosolitis**

(pronounced: air-o-sol-ite-is)



Dearborn improved polyamide anti-foams will

prevent this boiler disease

Tiny drops of water dispersed in the steam—called *aerosols*—cause superheater deposits, foul turbine blades. When this happens, your boilers have aerosolitis, and costly shutdowns and repairs will result.

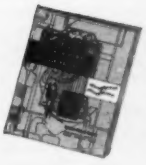
Preventing this boiler disease, which is more prevalent with some waters than with others, can be easily and inexpensively accomplished with Dearborn Improved Polyamide Anti-Foams which inhibit aerosol formation. In addition to this vital function, Dearborn Polyamide Anti-Foams prevent foaming to produce purer steam . . . eliminate scale formations . . . condition sludge . . . are compatible with other treatment.

If you produce steam for power or process use, investigate the benefits of Dearborn Improved Polyamide Anti-Foams.

Please Note Our New Address

DEARBORN CHEMICAL COMPANY

Merchandise Mart Plaza • Chicago 54, Illinois



Write for Bulletins

Informative bulletins are available on (1) Dearborn Improved Polyamide Anti-Foams, and (2) Dearborn Industrial Water Treatment and Engineering Service. The coupon is for your convenience.

Dearborn Chemical Company, Dept. PG
Merchandise Mart Plaza
Chicago 54, Ill.

Gentlemen: Please send:

☐ Bulletin on Dearborn Improved Polyamide Anti-Foams.

☐ Bulletin on Dearborn Industrial Water Treatment and Engineering Service.

Name.....

Company.....

Position.....

Address.....

City.....*State*.....

Dearborn

TRADE MARK REGISTERED

THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

POWER PLANT Construction News

Tempe, Ariz.—Salt River Power District, Tempe, has approved plans for new steam-electric generating plant on site about 5 mi. south of city, to be equipped for capacity of 30,000-kw. Work is scheduled to begin at early date, with completion in June, 1952. Cost reported about $5,000,000.

San Leandro, Calif.—Pioneer Flintkote Co., 5500 South Alameda St., Vernon, Los Angeles, Calif., building and roofing papers, plans boiler plant at proposed new plant at First Ave. and William St., San Leandro, where tract of land has been acquired. Proposed to begin work soon. Entire project reported to cost close to $2,000,000. Company is a subsidiary of Flintkote Co., 30 Rockefeller Plaza, New York, N. Y.

Greeley, Colo.—Home Light & Power Co., plans expansion in generating plant, with installation of additional equipment for increased capacity. Cost about $450,000. Proposed to begin work soon.

Wallingford, Conn.—Borough Electric Works, North Washington St., plans new municipal steam-electric power plant, with installation of turbine-generator, high-pressure boiler and auxiliary equipment. Cost estimated close to $4,000,000. Proposed to begin work this summer. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

Hennepin, Ill.—Illinois Power Co., Decatur, Ill., will proceed with work at once on proposed new steam-electric generating plant at Hennepin, previously referred to in these columns. Initial unit will have a capacity of 75,000-kw, and is scheduled for completion late in spring of 1953. Additional units will be installed at later date. Entire project reported to cost about $25,000,000.

Eddyville, Iowa—Iowa Southern Utilities Co., Centerville, Iowa, plans new steam-electric power plant in vicinity of Eddyville. Cost reported about $7,500,000. Pioneer Service & Engineering Co., 231 South La Salle St., Chicago, Ill., is consulting engineer.

Riverton, Kan.—Empire District Electric Co., Joplin, Mo., plans expansion in steam-electric generating station at Riverton, with installation of new turbine-generator, high-pressure boiler, and auxiliary equipment. Proposed to begin work soon. Entire project reported to cost over $6,500,000.

Danville, Ky.—Corning Glass Works, Inc., Corning, N. Y., plans boiler house at new plant at Danville, for manufacture of glass bulbs and tubing. Work on superstructure will begin soon. Entire project will cost about $2,000,000.

Belle Chasse, La.—Red Star Yeast & Products Co., Inc., 221 East Buffalo St., Milwaukee, Wis., plans boiler house at new plant at Belle Chasse, where site has been selected. Entire project estimated to cost about $1,500,000. E. A. Rose, Inc., 816 Howard Ave., New Orleans, La., is architect and engineer.

Millinocket, Me.—Great Northern Paper Co., Millinocket, plans new hydroelectric generating station on Penobscot River at Ripogenus dam, about 30 mi. from Millinocket, used for pulpwood log drives at present time. A 110,000-v transmission line will be constructed from new plant to mill for power supply. Entire project reported to cost about $6,000,000. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is consulting engineer.

West Springfield, Mass.—Western Massachusetts Electric Co., Springfield, Mass., plans addition to steam-electric power plant in vicinity of West Springfield, with installation of additional equipment for increased capacity. No estimate of cost announced. Proposed to begin work soon.

Caro, Mich.—State Dept. of Institutions, Lansing, Mich., plans new steam power plant at State Hospital at Caro, estimated to cost $370,000, including steam transmission line. Appropriation in that amount has been authorized.

Butte, Mont.—Montana Power Co., Butte, has arranged financing in amount of $6,000,000, through note issue, proceeds to be used for expansion and improvements in power plants and system, work to be carried out during present year.

Chamois, Mo.—Central Electric Power Co., 302 East High St., Jefferson City, Mo., has plans maturing for new steam-electric power plant in vicinity of Chamois, reported to cost about $3,000,000, with turbine-generator, boiler, and accessory equipment. H. A. Kuljian & Co., 1200 North Broad St., Philadelphia, Pa., are consulting engineers.

Atlantic City, N. J.—Atlantic City Electric Co., Kentucky and Pacific Aves., is arranging financing through the sale of additional shares of stock, to total close to $2,000,000, proceeds to be used for expansion and improvements in plant and system.

Charlotte, N. C.—Duke Power Co., 422 South Church St., Charlotte, has disposed of a bond issue to total about $35,000,000. Proceeds to be used for extensions in generating capacity, power sub-stations, transmission lines, and other operating facilities, scheduled to be carried out in 1951.

Sanford, N. C.—Burlington Mills Corp., Greensboro, N. C., plans power house at proposed new rayon weaving mill at Sanford, where tract of about 110 acres of land has been acquired. Entire project will cost approximately $2,000,000. Proposed to begin work soon.

Akron, Ohio—Ohio Edison Co. is arranging financing through sale of block of preferred and common stocks, to total about $15,000,000. Proceeds will be used in connection with 1951 expansion and improvements in power plants, power sub-stations, transmission lines and other operating facilities.

Athens, Ohio—Columbus & Southern Ohio Electric Co., Columbus, Ohio, plans installation of two 60,000-kw turbine-generators and auxiliary equipment at E. M. Poston power plant, near Athens. Entire project reported to cost over $20,000,000.

Chouteau, Okla.—Midwest Carbide Corp., Keokuk, Iowa, plans boiler plant at proposed new factory for production of calcium carbide, in vicinity of Chouteau, where site has been acquired. Entire project reported to cost about $3,000,000. Work scheduled to begin soon. Thomas F. Wetstein is vice-president and general manager.

Medford, Ore.—California-Oregon Power Co., Medford, has preliminary plans for new hydroelectric power plants in Klamuth River canyon area, to develop a total capacity of 100,000-kw, divided into several units. Entire project estimated to cost about $50,000,000, and will be carried out over a period of about 24 mos. Financing is being arranged.

Pittsburgh, Pa.—West Penn Electric Co., operating West Penn Power Co., West Penn Bldg., Pittsburgh; Potomac Edison Co., Hagerstown, Md., and other utilities, has arranged fund of about $36,000,000 for expansion and improvement in plants and system in 1951. Work will include construction of new steam-electric generating station at Albright, W. Va., with initial capacity of 150,000-kw; other increased generating facilities, power sub-stations and transmission lines.

Woonsocket, S. Dak.—Central Electric & Gas Co., 114 South 12th St., Lincoln, Neb., plans Diesel-electric power plant in vicinity of Woonsocket, reported to cost about $300,000.

Covington, Tenn.—Light & Water Dept. has approved plans for expansion in municipal oil engine-operated power plant, with installation of additional equipment. Proposed to begin work soon. Raymond B. Spencer, Covington, is architect and engineer.

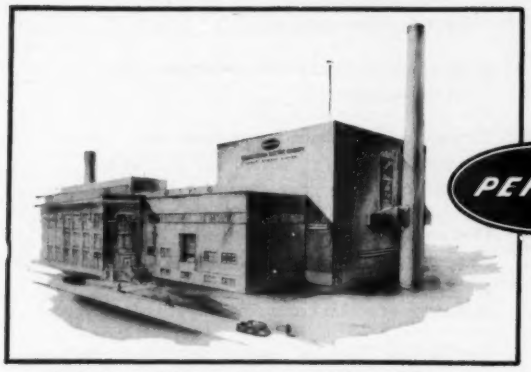
Houston, Tex.—Houston Lighting & Power Co. plans expansion in local steam-electric generating stations, with installation of three new 100,000-kw turbine-generators, high-pressure boilers, and auxiliary equipment. Work is scheduled to be carried out in 1952 and 1953; in that period, company has authorized a fund of about $111,000,000 for expansion and improvements in plants and system, including project noted.

Rivesville, W. Va.—Monongahela Power Co., Fairmont, W. Va., plans extensions in steam-electric power plant in vicinity of Rivesville, to increase capacity by about 80,000-kw. No estimate of cost announced—will represent large investment. Proposed to begin work this summer.

Ashland, Wis.—Lake Superior District Power Co., Ashland, plans expansion in local steam-electric generating station, with installation of new 20,000-kw turbine-generator unit, high-pressure boiler, and accessory equipment. Cost about $3,000,000. Work will proceed at once.

Janesville, Wis.—Wisconsin Power & Light Co., Madison, Wis., has authorized plans for new steam-electric generating plant on Rock River, near Janesville, with capacity of 120,000-kw, divided into two 60,000-kw units. Work on initial unit is scheduled to begin early in 1952. Cost estimated about $11,500,000.

PENNSYLVANIA ELECTRIC CO. Places 6th order for COPES Multi-Element REGULATORS



Front Street addition includes two 1250-psi, 950-F C-E boilers, each rated at 400,000 pounds of steam per hour.

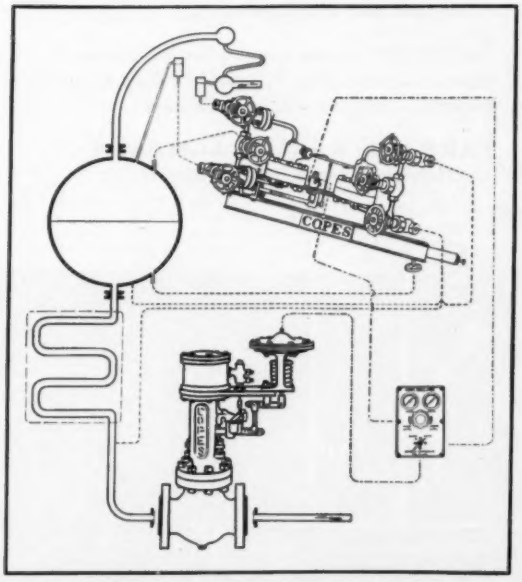
PENELEC

COPES Balanced Flow Control will be used for the 1952 Addition to Front Street Station of Pennsylvania Electric Company at Erie, Pennsylvania. This is the sixth time Penelec has ordered COPES Multi-Element Feed Water Control.

First installation was on the two original 675-psi boilers at Front Street, using two-element COPES Flowmatics. Two later orders placed Flowmatics on four 675-psi boilers at Seward. Two other orders equipped the four 875-psi boilers at Warren with COPES Flowmatics.

Now, for the Front Street Extension, Penelec has selected the COPES Balanced Flow—with control influenced by steam flow, feed flow and water level. This three-influence control is entirely independent of all other instruments and controls, and can remain on fully-automatic when they are out of service for routine inspection and care.

COPES Multi-Element Control is designed for the most modern boilers—for the most difficult operating conditions. Ask for proof of performance.



The COPES Balanced Flow Control, takes its control influences from steam flow, feed water flow and water level. Plant personnel can handle all maintenance easily; no need for "experts." The feed valve will stand up under *unlimited* pressure drops.

NORTHERN EQUIPMENT DIVISION
Continental Foundry & Machine Company
612 Grove Drive, Erie, Pennsylvania

Headquarters for **Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Alarms, Reducing Valves, Desuperheaters**

COPES

BOILER FEED WATER REGULATION

PRODUCE MORE WITH YARWAYS...

Is higher production your aim?

Then Yarway is your steam trap. Best steam trap performance requires condensate drainage *plus*—

1. **Air and gas removal.**
2. **Velocity scrubbing of condensate from heat transfer surfaces.**
3. **Keeping highest average temperature in the equipment.**

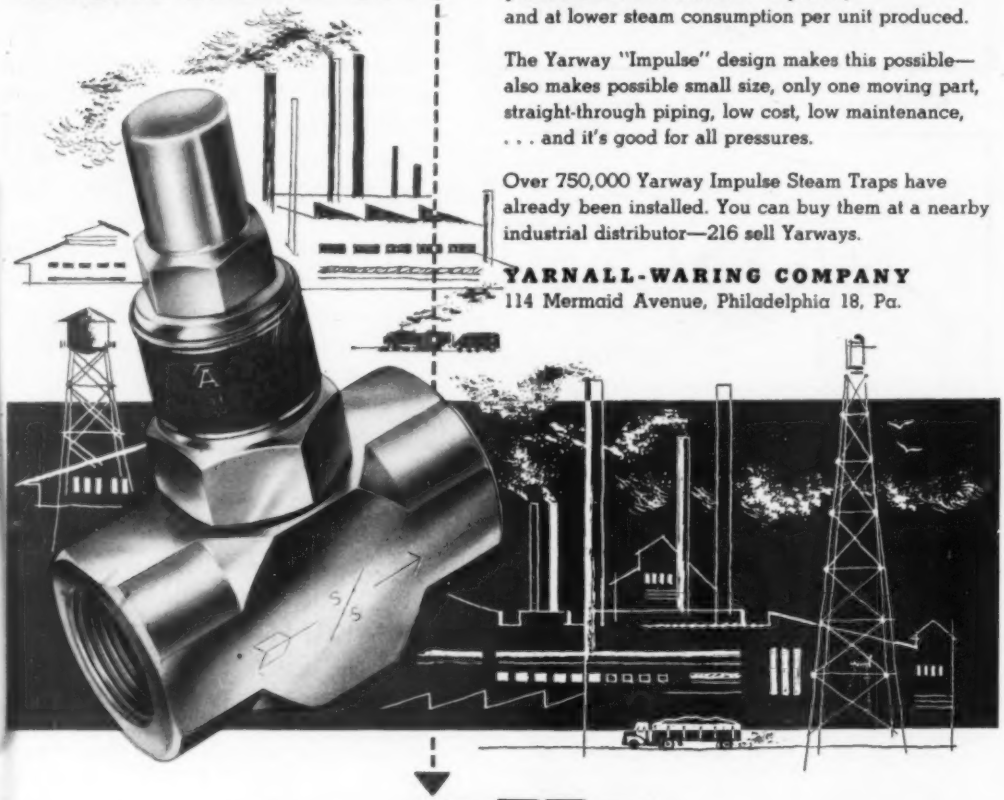
Yarway Impulse Steam Traps do all this, *sending the most premium B.T.U.'s at top temperature into your process or product.*

That's why equipment drained with Yarways gets "hotter, sooner" . . . why better quality and higher production rates are so often reported, and at lower steam consumption per unit produced.

The Yarway "Impulse" design makes this possible—also makes possible small size, only one moving part, straight-through piping, low cost, low maintenance, . . . and it's good for all pressures.

Over 750,000 Yarway Impulse Steam Traps have already been installed. You can buy them at a nearby industrial distributor—216 sell Yarways.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.



FREE OFFER
Don't take our word for it. Test Yarway's production advantages in your own plant, without cost or obligation. Drop us a card. A trial trap will be delivered promptly.

YARWAY the steam trap designed with production in mind

LETTERS TO THE EDITORS

GOOD ELECTRICAL SYSTEMS

THE ARTICLE by Paul C. Ziemke on Good Electrical Systems Make Industrial Profits (PE, March 1951, page 80) is very timely but hard to get across to busy plant managers.

Do you have available a sample procedure for making a load survey, as suggested in the article, also detailed instructions describing the use and purpose of the electrical testing instruments mentioned in the article?

Underloaded motors are probably the worst offenders we run into in attempting to rehabilitate electrical systems. But what can be done about them, when manufacturers, process men and others specify them merely to insure against stalling or to insure starting under full load or overload?

Thank you for your article and for any further information you can supply.

Massachusetts HERMAN BRETTMAN

Editor's Note—**Data on the instruments and methods used in making an electrical system survey are being supplied to Mr. Brettman and will also be published in a future issue.**

Everybody knows in a general way the effects of underloaded motors on an electrical system. But if the production men and others demand certain things for their own reasons and those conflict with good electric system practice, just exactly what can you do? Let's have some specific data from *Power Engineering* readers, something the other fellow can get his teeth into.

A SEMANTICIST IN OUR MIDST

IN YOUR APRIL issue, in the *Engineers' Preview* under the heading of "Brain Teaser" you should have a *very* red face. Instead of the reader not being able to read, the writer cannot write if he considers "a little over 3½ inches" the correct answer. By inserting the phrase, "the record turns 225 times from start to finish," the implied question is "How far does the needle travel in relation to the record, during the time required for one playing of the record?" I imagine this is the question you and most other people answered.

The unqualified question, "How far does the needle travel?" is answered by the resultant of: (1) The travel of the needle in relation to the earth from the time it becomes a needle until it ceases to be a needle, (2) the rotation of the earth about its axis during this period, (3) the travel of the earth in its orbit around the sun during this period, (4) the travel of our galaxy during this period and (5) the travel, if any, of the universe during this period.

"A little over 3½ inches," answers the question, "How far does the needle travel in relation to the record player during one playing of the record?" This question definitely is not the exact meaning of the words used nor is it implied.

This little problem illustrates how easy it is for the writer to confuse himself, also how hard it is to write words which say *exactly* what you *think* they say.

La Salle, Illinois J. B. WILSON

All right, Mr. Wilson wins! The needle travels umpteen million miles and our faces are very, very red indeed. Our hats are off to a dyed-in-the-wool semanticist. Now, then, what we would like to know is this: when this little problem is finally reduced to its ultimate solution, just in relation to WHAT does the needle travel those umpteen million miles? Ed.

CALCULATING A-C POWER

IN HIS ARTICLE "Power Generation from Wood Waste," Mr. Gusler, in reducing horsepower to killowatts, introduces 550 v, 1 ampere, and 80 per cent power-factor. I think it would have been clearer if he had simply multiplied the 2445 hp by 746, the number of watts in a horsepower.

In calculations about direct currents, the volts times the amperes gives the watts. But with alternating currents, the product of the volts times the amperes has to be further multiplied by a "power-factor" in order to get the watts.

Companies furnishing electric power usually measure direct current power by a watt meter. But on an alternating current circuit they often use an ammeter; and, to a certain extent, base their charges for power upon the current used, as well as upon the power used. This is because they have to install and pay for wires, transformers, generators and other equipment large enough to carry the current, regardless of the amount of the power they are furnishing, or the tons of coal they are burning. Thus they charge different rates per kilowatt-hour for supplying power to loads having different power-factors.

However, I see no reason for introducing this complication into a computation about power only.

In nearly every actual case, there are always a large number of factors, but it is simpler to consider each separately as far as is possible.

For example: — Does the figure 2445 represent the horsepower required to drive the wood working machines; or is it the horsepower (kilowatts) current needed by the motors; or is it kilowatts registered on the meter? The losses in the motors at full load will be around 15 per cent, with further losses in the wires and other equipment. If the meter is on the primary lines, about 10 per cent more should be added for transformer losses. In each case the exact figures depend upon many things.

Again: — The load factors vary greatly and are very uncertain. A plant making only a few items on a production line system will tend to have a high load-factor; while a plant making a variety of items will tend to have a low load factor.

Mr. Gusler has written a very interesting story and has brought out many good ideas. But it must be kept in mind that each plant is a different problem; and that many factors are involved in each; and it is no use in trying to include them all in one article. Therefore I hope to hear from him again.

P. H. TROUT

Roanoke, Va. Electrical Engineer

EDITORIAL POSITION OPEN

There is a position open on the Editorial Staff of *Power Engineering* for a qualified Assistant Editor. This is an excellent opportunity for a young man with a technical education who has an interest in technical editing and who wishes a permanent position with a 54-year-old organization. We prefer a man between 25 and 35 years old with a Bachelor's degree in mechanical or electrical engineering, one who has had several years of experience in some branch of the power industry. More important than formal academic technical training or degrees, however, are inherent interest in technical editing and evidences of aptitude for it. If you are interested, write to the Editor, *Power Engineering*, 110 South Dearborn Street, Chicago 3, Illinois.

Fig. 1. Preliminary model of the high-pressure, high-temperature steam power plant being constructed for the Societa Termo-Elettrica Siciliana, at Palermo, Sicily, under the European Recovery Program

Technical Aid for Foreign Power Projects

A brief description of the operations of the Kuljian Corporation in carrying out some of the objectives of President Truman's Point Four Program with respect to power development in foreign countries

AMERICAN foreign policy is inevitably concentrated today on the problem of checking Soviet expansion. This policy, as it has gradually evolved since the end of World War II, has two main parts. One is the policy of *containment;* that is, the prevention of overt Communist aggression against states not now under Communist domination. The other is *reconstruction;* that is, the removal in non-Communist states of conditions of want and insecurity which invite the spread of Communism. The first is the policy of the Truman Doctrines and the North Atlantic Pact, the second the policy of the Marshall Plan.

Engineers, both individually and as a class, should be vitally interested in the second part of our foreign policy—the Marshall Plan—since the carrying out of this plan depends largely upon engineering skill and talent, and the application of engineering principles to the solution of social and economic problems.

One of the greatest differences between the United States and the rest of the world lies in our great use of mechanical and electrical power. Today, we have available over 7 horsepower for every worker. It is this great power behind our workers that makes this country the greatest area of production on earth. Many of the European countries, of course, also have highly developed power resources but there are also great regions of the world where there has been relatively no power development or where the land has been so ravaged by war that the existing power development is wholly inadequate. These are the countries which President Truman referred to when, in his inaugural address on January 20, 1949, he enunciated his Point Four Program. This program has as its objective, the use of American technical knowledge for the improvement of many countries of the world. The development of the power resources of these countries and the consequent industrialization should be one of the most effective devices in which we can participate to prevent the spread of Communism.

A number of American firms have been active in the design and con-

Harry A. Kuljian, founder and head of the organization whose operations are described here, hardly needs an introduction to the old time readers of Power Engineering. Twenty-five years ago when he was chief engineer of The American Viscose Corporation, he wrote a number of articles for us, and in the years since then, we have described many of the power projects which he has designed and built. Aside from his long and intimate association with the power field, his inventive genius in developing rayon spinning machinery has made him a figure of national importance. Holding degrees in both electrical and mechanical engineering, a Fellow of the ASME, a member of the AIEE, and a registered professional engineer, Harry Kuljian ably directs the activities of the world organization which he has built up during the last twenty years. He had his early training with Stone & Webster, The American Viscose Corporation, RCA Manufacturing Company and others. He founded H. A. Kuljian & Company in 1930. Today, the Kuljian Corporation is international in scope; having engineered and constructed power and industrial projects in Venezuela, Mexico, Belgian Congo, India, China and Chile, together with surveys and studies in many other countries.

struction of foreign plants but none have gone into it with the vision and breadth of action as has the Kuljian Corporation of Philadelphia, Pa. Sensing the need, and confident of the technical skill of the engineering organization he heads, Harry A. Kuljian, after the war established offices in Mexico City, Mexico; in Caracas, Venezuela, Rome, Italy, and in Calcutta, India, so as to be able to carry on construction projects almost anywhere in the world. During the war, under the sponsorship of the State Department, the Kuljian Organization had engineered eight large steam power plants for allied countries in Europe under the Lend-Lease agreement. These plants were designed and the equipment selected and adapted for European use. The experience gained in these war-time operations has been put to good use in the post-war period, and at the present time, they have power plant projects under way in Italy, India, Mexico and Chile.

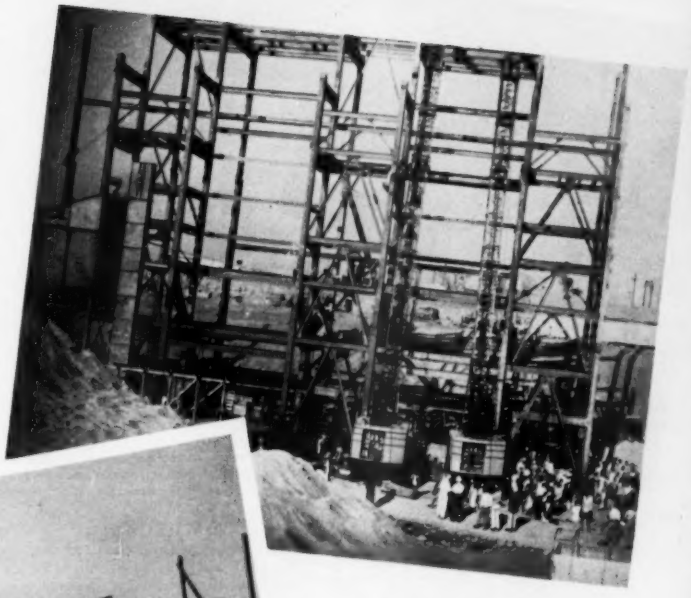


Fig. 2. (Above) Construction view at the Bokaro Station in the Damodar Valley in India. This plant which will have a capacity of 240,000 kw will be the largest power plant in the Far East

Fig. 3. (Left) Cutting local sandstone for sample of random Ashlar stone work at the site of the Bokaro power station in India. American engineers' bungalows in background

Bokaro Plant to Have 240,000 kw

The largest of these is the Bokaro Station for the Government of India. The details of this station, the largest in the Far East, will be described in an article in a subsequent issue. The engineering and construction, and initial operation of this power plant of an ultimate 240,000 kw involves an initial expenditure of $35,000,000. The construction of this large plant in the Damodar Valley 200 miles northwest of Calcutta involved innumerable problems concerning men and materials. Some of the methods used on projects of this kind in these far away places might seem expensive, time-consuming and inefficient to American construction engineers, yet if the social and economic aspects of the whole situation are considered, the methods will be found the most suitable. In excavating the site for the Bokaro Station, for example, over 600 coolies were used in transporting rock, using baskets which they balanced on their heads. As far as the operation itself is concerned, this was cheaper than using machinery. In other words, wherever possible, use is made of native labor. Another example of how local labor is employed is shown in Fig. 3. This shows natives at work cutting sandstone for samples of random Ashlar stone work. This is done laboriously by hand, but the workmen are skilled and the finished product excellent. Again, this is the cheapest and most satisfactory way of doing the work.

These two examples are indicative of the importance of the human aspects involved in these projects. Every effort is made to contribute something to the welfare of the local population in all phases of construction. Major equipment has to be purchased abroad in the United States. In this case the operations are directed from the Calcutta office of Kuljian but the engineering is done in the main offices at Philadelphia. Kuljian engineers will start the operation of this plant when it is finished, together with a group of Indian engineers who received extensive training at the Kuljian offices in Philadelphia and with various large utilities, manufacturing plants, etc., in the United States. After one year of operation under this joint arrangement, the entire project will be turned over to the Damodar Valley Corporation.

Another large project is the high-temperature, high-pressure steam power plant at Palermo, Sicily. This plant will have an ultimate capacity

Fig. 4. A view of the completed La Cabrero power plant of La Electricidad de Maracay in Venezuela

of 90,000 kw and will cost approximately $15,000,000. This project is financed by the European Recovery Program of the United States Government, and will function as a part of the West European Defense System. This plant is being built for the Societa Termo-Elettrica Siciliana, a public utility, supplying electricity to the City of Palermo and surrounding territory. The initial installation consists of two 30,000-kw, 3000 rpm, 50-cycle tandem compound double-flow exhaust turbogenerators. The steam ends are designed for 850 psig, 900 F steam at the throttle. The units are provided with four extraction points. The generators are designed to deliver current at 10,500-v, 3-phase, 50 cycles, and are hydrogen cooled.

Steam for these units is supplied by two boilers each producing 305,000 lb of steam per hr continuously, with a maximum 2-hr rating of 320,000 lb per hr.

The Palermo plant is laid out on the unit system basis of a single boiler feeding a single turbogenerator. One similar 30,000-kw unit will be added in the near future to bring the ultimate capacity of the station up to 90,000-kw. The first and second units are scheduled for initial operation in April 1952, and August 1952 respectively.

Mediterranean Sea water will be used as circulating water for the condensers. The use of sea water is, of course, not unusual where plants are located close to tide water but a feature of the water supply that is unusual at this station is that the make-up water for the boilers and the water for station service also will be sea water. Water is a critical commodity at Palermo and a study of the water conditions revealed that the best supply for boiler make-up and station service would be from single effect salt water evaporators. Provision for the use of Palermo city water for boiler make-up has been made, however, should the critical water shortage be alleviated in the future.

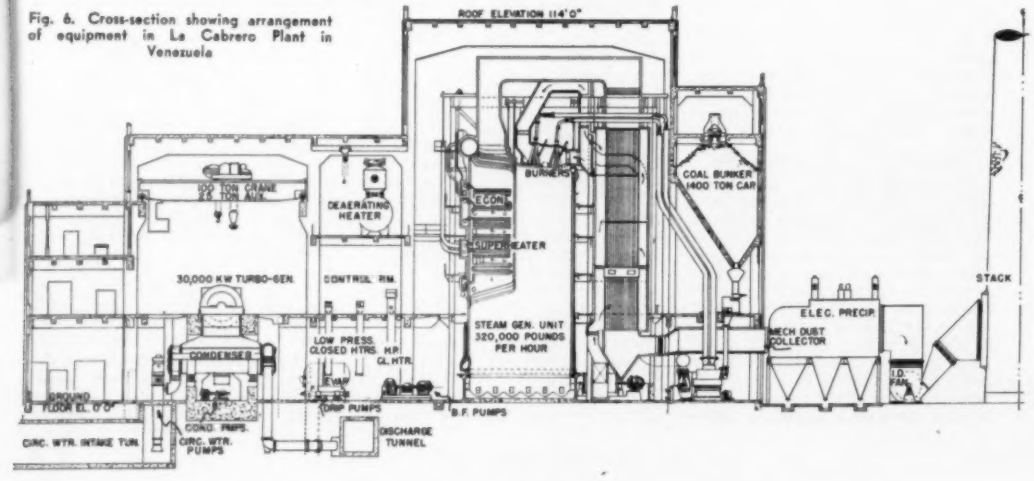
The station is designed to burn pulverized coal which will be shipped in barges from mines in Sardinia. Provision has been made for the future installation of oil burning equipment should it become desirable to convert at any time in the future.

In the construction of this station every effort was made to obtain equipment in Europe where possible, provided that deliveries could meet the construction schedule. This was done with the coal handling equipment and in certain other items of mechanical equipment. This practice again is in line with the basic purposes of the ECA program—that of rendering economic assistance to the Marshall Plan countries. In this instance the Kuljian Corporation are the mechanical and electrical engineers responsible for the design of the station. The Societa Progettazione Impianti Termo-Elettrica Industriale of Rome, Italy are the architectural and structural engineers, and the constructors of the project. Although the two organizations are separated by 4200 miles, there has been prefect coordination and the design and construction has progressed in record time.

South American Power Projects

In another part of the world, far removed from both Italy and India, is the steam plant for a complete integrated steel plant located on the shores of the Pacific on San Vincente Bay near Concepcion, Chile, 300 miles south of Santiago. This plant, for which Kuljian is the consulting engineer, comprises two 70,000 lb per hr Combustion Engineering boilers and one 3125-kva, 3000 rpm turbogenerator, complete with condensing and other auxiliary equipment.

Fig. 6. Cross-section showing arrangement of equipment in La Cabrero Plant in Venezuela



The steel plant which this power plant will serve will be the most southerly integrated steel works in the world. It is being constructed by Compania de Acero del Pacifico with the Koppers Company of Pittsburgh collaborating in its construction. Koppers, also, will participate in its future operation through a co-management contract with Acero.

Base fuel for this plant will be coke breeze of approximately 10,000 Btu per lb, supplemented by coke oven gas to the limit of its availability, and *dumped* blast-furnace gas to meet load requirements.

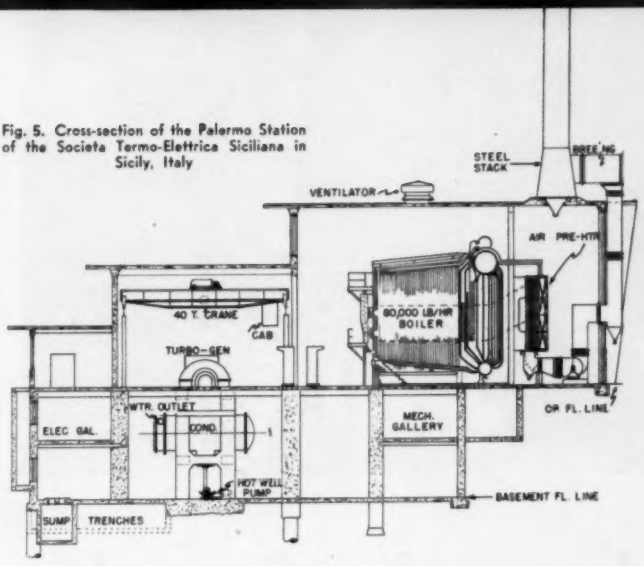
Although a steam turbine generating unit is installed at this plant, it is intended only for standby use. Normally, all electrical energy will be supplied from Endesa's new hydroelectric station at Albanico 90 miles away. This power will be brought in at 154,000-v to the Company's main substation. One of the features of this station, therefore, is in the provisions which have been made to insure continuity of power from Endesa. To enable the steel plant to empty furnaces, pour ladles and in general prepare for limited shutdown, as well as insure continuity of gas flow, the turbine-generator is arranged so that it can always be put on the line in ten minutes or less. It will be provided with a simple turning gear which will maintain it in a ready condition at all times. Also, in case of power failure, all emergency air will be supplied by turbine-driven compressors.

La Cabrera Power Plant

North, from the Chilean plant but still in South America, is another Kuljian plant. This is the La Cabrera Power Plant of La Electricidad de Maracay, a public utility supplying electricity to the nearby city of Maracay, Venezuela. This plant which has just been completed, is owned and operated by C. A. La Electricidad de Maracay, a department of the federal government, which also has three other plants, a Diesel station, and two small hydroelectric plants.

This station consists of two 7500-kw, 13,800-v, 3-phase, 50-cycle turbogenerators supplied by three 80,000 lb per hr, 415 psig, 725 F steam generating units, fired by oil from local Venezuela oil fields and refineries. Condenser water is obtained from Lake Valencia, which adjoins the power plant site. This lake is fed by mountain streams assuring a constant supply. Boiler make-up is obtained from nearby artesian wells. Since it is anticipated that natural gas may become available in the near future, provisions have also been made for burning gas.

Fig. 5. Cross-section of the Palermo Station of the Societa Termo-Elettrica Siciliana in Sicily, Italy



Construction of the Cabrera plant was started in March 1948, and the plant was placed in operation towards the end of 1949. Space has been allocated for future expansion and provision also has been made for the easy conversion of all major equipment in the station from 50 to 60 cycle current.

In this project, the International General Electric Company was the prime contractor and the Kuljian Corporation, the consulting engineers.

These brief descriptions will serve to indicate the worldwide character of Kuljian's operations and at the same time show the nature of the work being done. In carrying out operations of this kind in foreign lands it is essential that the attitudes and social and economic problems of the people in these foreign countries be taken into account in all aspects of the work. The primary purpose of Truman's Point Four Program is to help the people of the economically underdeveloped areas, who comprise a large part of the world's population, in their efforts to develop their human and natural resources, to increase their productive capacities, and to raise their standards of living. Most of the world is in the throes of a social revolution. In Asia and Africa, where people have little freedom to lose, the threat of Communism is great. With the breakup of colonial imperialism, Communism tends to rush in and fill the vacuum. If, somehow, by this kind of assistance, enabling people to retain their independence and well being, we can dissolve their anxieties and fears, we will be helping not only them but ourselves as well. The Kuljian organization, with its far flung points of contact and Harry Kuljian's own understanding of foreign point of view, is in an admirable position to carry out operations of this character.

Fig. 7. Group of 11 engineers sent by the government of India at their final briefing session in the Kuljian headquarters in Philadelphia. Kuljian chief engineer, H. H. Levonian, third from left

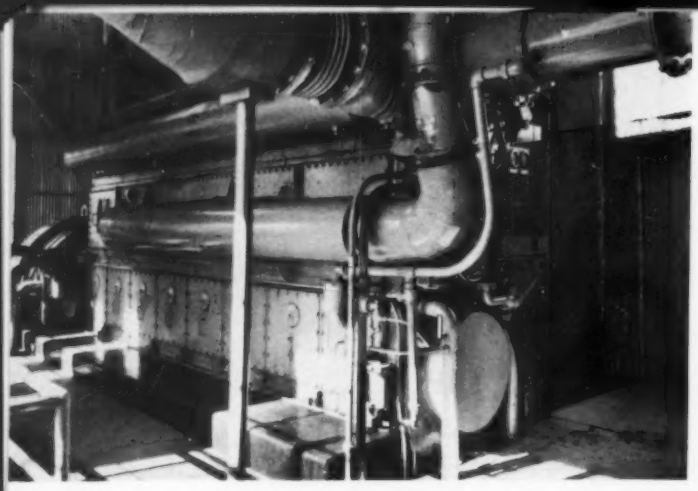


Fig. 1. View of the Nordberg 4-cycle Diesel engine at the Arizona Edison Company plant at Miami, Arizona, showing the supercharger and intercooler which have greatly reduced the losses due to high altitude and high ambient temperature

Intercooling Supercharged Four-cycle Diesels

NEXT TO IMPROVEMENTS that added to the dependability and better performance of the Diesel engine, designers have long endeavored to increase the power that could be obtained from an engine of given size and speed. To see the progress that has been made, it is only necessary to compare the overall dimensions, weight and output of an early engine with a modern Diesel.

One of the more important advances made in obtaining increased power output was the application of supercharging. It is now common practice with most builders to supercharge four-cycle Diesel engines. The advantages of supercharging result from the fact that more air can be forced into the cylinder than is possible with a naturally aspirated engine and more fuel can be burned with a resultant proportional increase in power at no higher combustion temperature. One of the factors that makes this possible is that a considerable amount of air cooling is obtained by allowing cool intake air to blow through the cylinder during a part of the exhaust and early part of the intake strokes, thus carrying more heat out with the exhaust. By increasing the power through supercharging, a given engine will have less weight per horsepower, more power for the space occupied, will cost less per horsepower for engine and its installation, and will have an improved fuel consumption over the entire range. In supercharging Nordberg Diesel engines, an exhaust gas driven turbocharger is driven by the exhaust gases and takes no power from the engine.

There are two systems of supercharging — low pressure and high pressure. Only low pressure supercharging is considered here since it is more commonly used at the present time.

Most modern design Diesel engines, although structurally able to carry far greater horsepower, have reached the point where their safe rating for continuous service is determined by the ability of the surfaces in contact with the combustion gases to stand the temperatures without heat failure or destruction of piston ring lubrication. Non-supercharged, four-cycle engines of modern design are rated at about 80 lb bmep while low pressure supercharged engines operate at about 120 lb bmep in continuous service. Many hundreds of thousands of horsepower in Diesel engines in successful service have proven these ratings to be conservative.

The Diesel Engine Manufacturers Association Standards provide that Diesel engines shall be rated on the basis of 90 F intake air conditions. To maintain the same average combustion temperature and heat load to the cooling water it is necessary to reduce the engine rating about 3 per cent for each 10 degrees in intake air temperature above 90 F. It follows therefore that engine rating can be increased about 3 per cent for each 10 degrees F in air temperature below 90 F.

High intake air temperature affects the engine rating in two ways. First, there is less air available to burn the fuel because the density and weight of air in the cylinder decreases with increasing temperature; and second, the average temperature during the combustion stroke increases about two degrees for each degree increase in intake temperature. Thus, less fuel can be burned (less horsepower produced) before the maximum safe

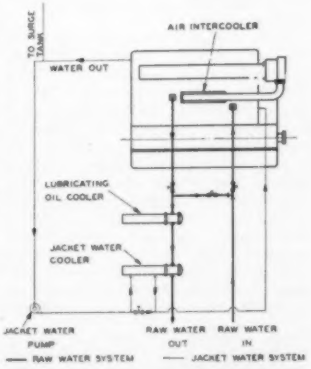


Fig. 2. Jacket and raw water cooling systems showing location of the intercooler

temperature will be reached.

The low pressure turbo-supercharged Diesel engine could be rated 15 per cent higher with equal conservativeness except for the fact that in increasing the air pressure to 3½ or 4 lb, the intake air temperature rises from 90 F at the blower intake to about 140 F at the blower discharge. Thus, the higher air temperature detracts considerably from the advantages of 3½ to 4 lb air pressure.

It is obvious from the above that the next step in increasing the rating of a supercharged Diesel engine is to cool the intake air after the supercharger. If cooling water is available at a temperature which will permit bringing the intake manifold air temperature back to 90 F, the rating of the engine can be increased 15 per cent with no increase in average combustion temperature or heat load to the water jackets. This can be done by a simple, finned tube type of air-to-water heat exchanger built into the engine and through which the cooling water is circulated before going to the engine jacket water cooling system.

An economical design of intercooler will reduce the intake manifold temperature to within 15 degrees of the water temperature. Thus, 90 F water to the intercooler will result in 150 degrees F air temperature to the engine. Since the normal rating of the low pressure supercharged engine is based on 140 F air temperature to the engine the use of the intercooler permits an increase in rating of 10.5 per cent.

$$140° - 105° = 35°$$

$$\frac{35\text{ F} \times 3\%}{10} = 10.5 \text{ per cent}$$

While a non-intercooled engine must be derated for intake air temperature above standard conditions of 90 F, the intercooled engine is independent of intake air temperature and its rating is determined by the water temperature to the intercooler. For example, a non-intercooled engine installed where summer temperatures reach 110 F must be derated 6 per cent in horsepower. Under these conditions the manifold temperature after the supercharger will be 163 F. By applying an intercooler and using 90 F cooling water the manifold air temperature will be reduced to 105 F. Thus, as in the preceding example, the engine can be rated 10.5 per cent above the normal rating for a non-intercooled engine operating with standard conditions of 90 F intake air.

The effect of supercharging and intercooling on the ratings of 16 in. bore, 22 in stroke, 327 rpm, four-cycle stationary Nordberg Diesel engines is shown in the following tabulation.

The rating shown for the supercharged, intercooled engines is based on 90 F. water to the intercooler and 105 F. air temperature in the manifold.

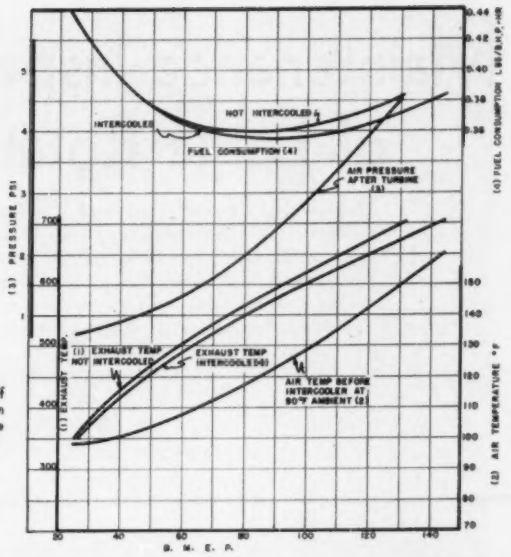


Fig. 3. Effect of intercooling on Nordberg 4-cycle engine performance

No. of Cylinders	Non-Supercharged 80 BMEP	Supercharged 120 BMEP	Supercharged Intercooled 132 BMEP
5	730	1090	1200
6	875	1310	1440
7	1020	1530	1680
8	1165	1750	1920

The curves in Fig. 3 show the effect of intercooling on four-cycle supercharged Nordberg engine performance. A schematic arrangement of the jacket and raw water cooling systems of a supercharged intercooled engine is shown in Fig. 2.

Typical applications of four-cycle supercharged and intercooled Nordberg Deisel engines are the installations at Menasha, Wisconsin Municipal Power Plant, Fig. 4, and the Owens-Corning Fiberglas Corporation, Santa Clara, California, Fig. 5. At Menasha a six cylinder, 16 by 22

(Continued on page 126)

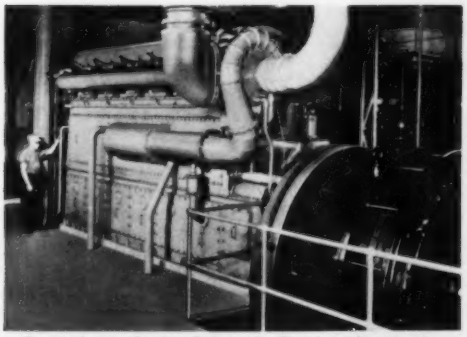


Fig. 4. Intercooler installed on the Diesel at the Menasha, Wisconsin, Municipal Power Plant

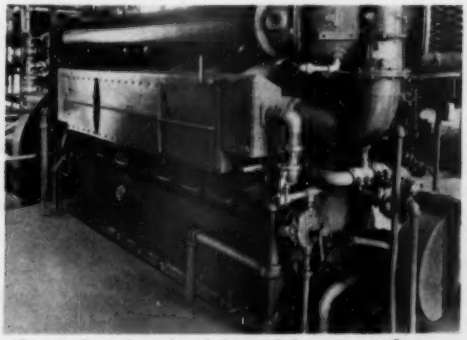


Fig. 5. Supercharged and intercooled engine at Owens-Corning Fiberglas Corp. at Santa Clara, Calif.

Maintenance Inspection and Testing of Large Rotating Machines

Because of their great importance it is highly essential that the insulation of large generators and synchronous condensers be maintained at its highest state of effectiveness at all times. To prevent failure an inspection and testing program that will indicate points of weakness in advance of failure is, therefore, of primary importance in the maintenance of such machines. This article, which is based on a paper presented by the author before the American Institute of Electrical Engineers, describes the details of such a maintenance program, as developed by the engineers of the Westinghouse Electric Corporation

By JOHN S. JOHNSON

A-C Engineering Department, Westinghouse Electric Corporation, East Pittsburgh, Pa.

THE INSULATION of large, high voltage rotating machines—turbine generators, hydroelectric generators and synchronous condensers—is of sufficient importance to justify planned maintenance with the objective of preventing failures in service. A successful program of this type may be expected to permit the correction of many potential troubles in an orderly fashion before service interruptions occur. Since manufacturers have always been interested in, and felt a responsibility in field performance and proper maintenance, Westinghouse engineers have initiated a maintenance inspection service which will make available to users of Westinghouse machines an integrated program designed to promote the greatest possible usefulness of these machines. This program will encourage consultation with operators and bring to each user the experience gained from a knowledge of over-all service experience. Also it will provide for a more systematic accumulation of performance experience to be used as a guide in the development of improved manufacturing and control methods, and methods of inspection and testing.

Fig. 1. With a cystoscope containing a tiny lamp and lens, an inspector makes minute examination of the insulation surfaces

High voltage machine insulation is subjected to physical stresses caused by varying temperatures and electrical stresses during cyclic loading. These stresses vary with the size of machines, their individual design, and degree of loading.

The development of suitable high voltage machine insulations has been an evolutionary process. While the basic insulation has been mica since the early years of this century, the form of insulation, bonding resins, and supporting structure has changed. Materials and insulation processing techniques have changed radically over the years and insulations on modern machines are distinctly different from that on earlier units. The physical size of machines had also increased and will continue to increase. Thus a knowledge of the particular type of insulation on a given machine and the performance obtained with it have an important bearing on the unit's maintenance.

Tape Separation

Under conditions of severe stress a phenomenon called tape separation may occur. Basically, this occurs where stator coil insulation is

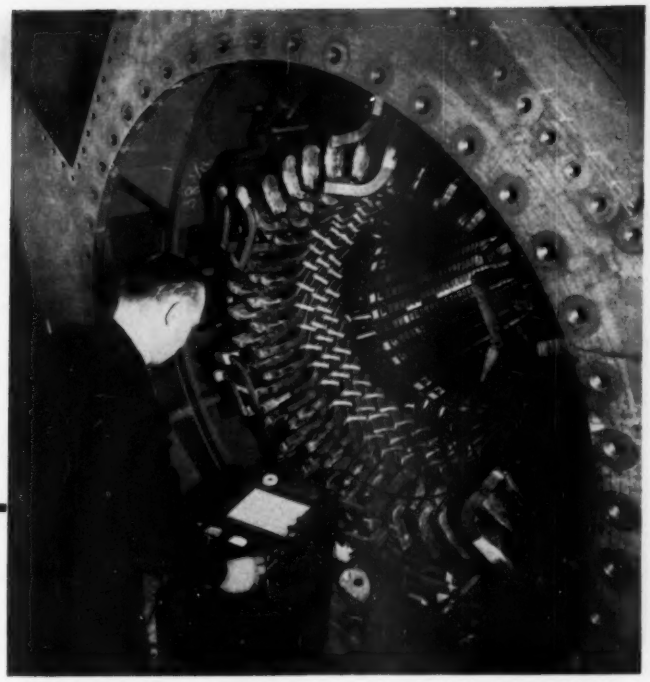


Fig. 2. High-voltage equipment for the d-c overpotential test shown attached to coils of a medium-sized 3600-rpm generator

unable to follow the successive expansion and contractions of copper conductors. Such separations fall into two classes, the most frequent being known as a superficial or surface separation. In this type the insulation migration occurs in such a manner that the dielectric strength of the coil insulation is not significantly reduced. The other and relatively rare type is called acute separation. In this type the insulation migration produces a serious fracture of the insulation at vulnerable points. Under such conditions operation is hazardous and the coil insulation must be repaired or replaced.

The first few years of operation appear to be the most critical with respect to the possibility and the seriousness of tape separation. Most machines under average conditions of use do not have, or have only a negligibly small amount of tape separation. Short machines generally do not have tape separation.

Acute tape separation has been observed on several relatively long hydrogen-cooled turbine generators, but many such machines have been inspected which show no evidence of separation. There are, however, a number of turbine generators which have superficial separation in varying amounts and it is, therefore, important to watch for these conditions and to note trends.

Corona and Slot Discharge Effects

Prevention of corona in the straight portions of the coils resting in the slots of stator windings is accomplished by coating these coil surfaces with a low resistance conducting finish such as the varnish-base compounds in present use. In the past colloidal graphitic water suspensions were used. These successfully eliminated corona for over 20 years but in a few cases difficulties arose from a loss of electrical contact between the conducting coil finish and the core. This loss of contact, which was limited entirely to the top or last coil side placed in the slot, resulted in an intense capacitive discharge between the ungrounded coil sides and the core. This phenomenon, called a *slot discharge,* can be seriously destructive to the coil surface finish and the ground insulation if it continues.

When this phenomenon was first discovered, an investigation of the problem was undertaken. This involved the construction of a core model in which it was possible to study in the laboratory the factors which might lead to the development of surface discharging. The phenomenon was successfully reproduced in the laboratory under severe test conditions. The process modifications designed to overcome the tendency for discharge phenomena were subjected to rigorous tests including high voltage, temperature cycling and severe vibration.

The incidence of this sort of difficulty has been found to be very small. The fact that the possibility (however remote) of trouble from this phenomenon exists necessitates the development of suitable testing equipment for detection of discharging and also the development of suitable and economical corrective measures which can be made when difficulty is encountered. Slot discharge detection equipment has been developed and will be described in a later section of this paper. Corrective treatments have been developed which are effective and economical in suppressing surface discharging.

End Winding Corona

End winding corona is effectively minimized in modern windings by stress relieving semi-conducting finishes and by providing suitable spacing between stressed members. Also the use of inorganic binder tapes, twine, "Micarta" spacers and synthetic resins with inorganic pigmentation, provides surfaces highly resistant to the deteriorating effects of corona. Generally speaking, even a fairly high level of end winding corona is not a serious hazard and does not significantly limit the usefulness of a machine insulation. In unusual cases, however, attempts have been made to reduce end winding corona on machines in service. It has been found possible to materially improve conditions by suitable treatments. Reduction in end winding corona by this means however, is achieved by some increase in stress on portions of the end winding insulation. Usually treatments recommended are dictated by observed conditions taking into consideration the design and construction of the machine.

Conductor insulation of multi-turn stator coils of large rotating machines is designed with large fac-

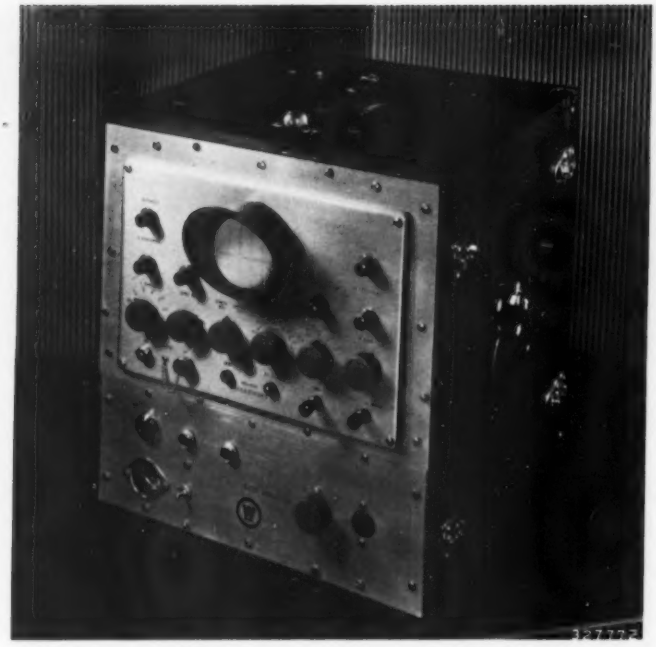


Fig. 3. This is the slot discharge analyzer used for detecting and locating slot discharges

tors of safety. Also, this insulation is subjected to high over potential tests during manufacture. Nevertheless, a certain percentage of winding failures probably originate as turn-to-turn faults. Obviously, then, it is desirable to test this insulation at voltages above normal operating stress, and a method has been developed for surge testing the conductor insulation of large machines at voltages up to several times the operating voltage. This is a routine test for certain types of machines at the factory but the equipment is also available for field tests.

Causes of Failure

While failures of stator windings in large machines are of relatively rare occurence, those that do occur, are likely to have their origin in the certain unusual conditions rather than to the effects of prolonged electrical stress at normal operating conditions. For example, failures are far more likely where something has occurred to destroy the physical integrity of the insulation. Probable causes are: cracking of the insulation from unusual mechanical stresses, insulation distress from physical forces caused by thermal effects or unusual vibration, operation at temperatures which tend to degrade the organic constituents which support and bond the basic mica insulation, insulation deterioration from surface discharges caused by loss of contact between conducting coils surfaces and core, eroding effects of foreign magnetic particles embedded in or lodged against the coil insulation, contamination by substances affecting insulating strength — most common, moisture contamination.

Maintenance Tests

Suitable tests can be useful to supplement visual inspection in determining the suitability of machine insulations for service or to disclose undesirable conditions in need of corrective maintenance. No single test is available that will give all necessary information concerning the condition of the insulation. There is a sound basis, however, for expecting that a combination of thorough visual inspection and proper interpretation of available tests permit a reasonable estimate of probable insulation condition at a given time. Periodic tests and inspections then may be expected to establish conditions of the insulation over a period of time. Reasonable extrapolation of the performance trend thus established would be justified. There are a few basic tests, outlined in the following paragraphs, that give excellent indications of insulation condition when properly interpreted in the light of information gained from visual examination by experienced service men.

General Non-Destructive Tests

The so-called non-destructive tests such as insulation resistance, power factor, polarization, ionization are of greatest value when they may be related to physical conditions or changes that may be occurring in the insulation. In many cases the absolute measured values are of themselves of limited significance. It must also be remembered that large insulation areas are involved in machine windings and that discreet areas of weakness would not be expected to significantly affect the characteristics as determined for the entire winding. The greatest significance of such tests then would be to indicate over-all trends.

A sudden drop or a sustained downward trend in insulation resistance might be subject to different interpretation depending on whether it was measured on the stator or rotor. Different levels of insulation

(Continued on page 120)

Fig. 4. This photograph shows the slot discharge analyzer in use in making a test on a turbine generator

Moist Combustion Air Lessens Fireside Deposits

To state it more technically, deposits on firesides of steam generating units have been minimized by humidification of combustion air . . . Increasing humidity of air to at least 16 lb water per 1000 lb dry air greatly decreased deposits in stoker-fired units at Delray Plant of The Detroit Edison Co. . . . Higher boiler efficiency compensates for added water; pronounced gain in availability and lower maintenance

OF THE Detroit Edison Company's steam generators, three at the Delray Plant have been plagued the most by fireside-deposit troubles, particularly in the superheaters.

Within a few days after being placed in operation, the front loops of the superheaters became fouled with sponge-ash and shortly thereafter with hard deposits. Early efforts to overcome deposit troubles consisted of damper and baffle changes, changing the nozzles of integral soot bolwers to pass twice the original amount of steam, changing from saturated to superheated steam in these blowers, and using telescopic soot blowers in the superheater area. None of these measures corrected the situation.

Four additional steam generators, similar to the three mentioned, except for details, were installed later, In addition to superheater fouling, considerable fouling also occurred in the economizers and air preheaters.

Until recent years, three other troubles aggravated and confused the problem of fireside deposits; secondary combustion, superheater-tube wastage, and stoker blocking by wet coal. Gradually these problems were partially eliminated. Troubles from fireside deposits, however, remained as a vicious cycle in which fouled heating surfaces caused higher preheated-air temperatures, which in turn caused stoker-iron burning and increased fouling.

Remedies Previously Tried

Many possible solutions were tried and others considered. Use of lime, both as a solid additive to the fire and as a slurry to cover cleaned heating surfaces, was a failure. Small-scale experiments with coatings of graphite and aluminum, applied as paints to superheater tubes, showed these materials also to be ineffective in preventing formation of superheater deposits or in facilitating their removal. The only improvement in boiler availability came through better cleaning by a combination of scraping, blowing, sandblasting, and alkaline-water washing. Improvement in availability was only slight.

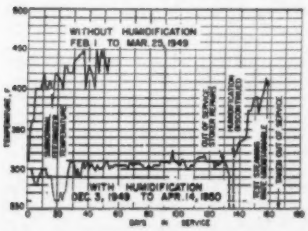


Fig. 1. Effect of humidification of combustion air on stack gas temperatures measured at air-preheater outlet. Steaming rate 325,000 lb per hr

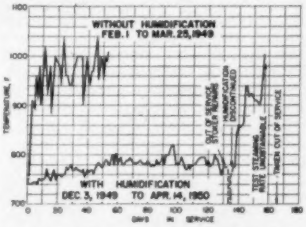


Fig. 2. Effect of humidification of combustion air on boiler-outlet-gas temperature. Steaming rate 325,000 lb per hr

Various theories and methods of combating the trouble were reviewed by Paul Murphy, Jr., J. D. Piper and C. R. Schmansky, all of the Detroit Edison Co., in a paper before the annual ASME Meeting, New York, December 1950. They then brought out the following points:

For many years it had been known that superheater deposits formed more rapidly in winter than in summer at Delray. This phenomenon was often ascribed to the stoker troubles caused by the wet coal encountered in winter. In 1944 a suggestion was made that the difference between winter and summer behavior might be related to the difference in the amount of moisture in the combustion air of these two seasons. An early attempt to correlate the amount of moisture in combustion air with steam generator behavior was unfruitful. In 1949, however, the possibility of correlation was carefully analyzed.

Decision was made to try a humidification run on Delray Steam Generator No. 7 which has the close superheater-tube spacing. The total input of moisture was arbitrarily set at nearly the maximum for summer conditions of 7000 lb per hr for a steaming rate of 325,000 lb per hr; that is, approximately 16.4 lb per 1000 lb of dry air. Because the amount of moisture in the atmospheric air changes rapidly, flexible control was provided for the experiment so that the amount of added moisture could be adjusted every hour to compensate for changes in the absolute humidity of the outdoor air. The moisture was introduced into the preheated air as saturated steam. The amount of moisture so added was adjusted for each 25,000-lb-per-hr change in steaming rate.

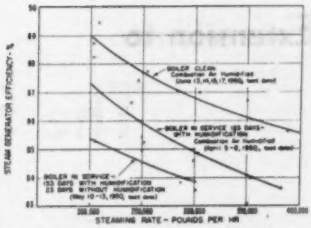


Fig. 3. Steam generator efficiency during humidification tests on No. 7 boiler. Efficiency computed from losses, following ASME Test Code for Steam Generators

Effect of Humidification on Performance

The effect of humidification on the performance of No. 7 is shown in Figs. 1 and 2.

During the entire 133 days of operation with humidification, the steam generator was capable of steaming 400,000 lb per hr; after 24 days without humidification the maximum steaming rate obtainable was 300,000 lb per hr. Details of temperatures, deposits and operation under the various conditions are given in the complete paper, and results of tests are shown in Fig. 3. According to information available to date, the humidification requirements for Detroit climate will be 1.3 per cent of the steaming rate when averaged over an entire year. During the coldest part of the winter indications are that the requirements may be approximately 2 per cent.

It should be pointed out that further data will have to be obtained before the effect of humidification on boiler efficiency can be evaluated adequately. Until such time as more data are available it seems probable that humidification, through keeping heating surfaces cleaner, will improve average efficiency at least enough to compensate for the cost of its use, thus leaving a distinct gain through better availability and lower maintenance. The economic and engineering aspects of the problem are being further studied.—ASME paper No. 50-A-86.

Extension to

The Steam Plant at the University of Idaho

Installation of a new spreader-stoker-fired boiler at the plant of the University of Idaho enables plant to make better use of varied coal available in vicinity of Moscow, Idaho. New unit operates at over 81 per cent efficiency on performance tests

By HENRY F. GAUSS
Research Professor, Department of Mechanical Engineering, University of Idaho, Moscow, Idaho

THE RAPID GROWTH of the campus at the University of Idaho during the past 25 years has necessitated three major additions to its central heating plant.

The first involved the complete removal of the plant from a location in the midst of other buildings to a more remote corner of the campus. This greatly reduced the dirt and dust produced by trucking coal and refuse, and removed unsightly smoke stacks from proximity to administration and classroom buildings. In its new location the plant included a 300-hp Keeler horizontal water tube boiler, a 250-hp Keeler horizontal water tube boiler, and a 500 hp 4-drum, Sterling water tube boiler. Coal could be delivered by rail and trucking was eliminated.

The second modification consisted of the addition of a pulverized coal fired steam generator having a capacity of 30,000 lb of steam per hr.

The third modification consisted of replacing the existing Keeler boilers with a spreader stoker-fired steam generator having a capacity of 40,000 lb of steam per hr.

The results of an acceptance test on the pulverized coal-fired steam generator installed in the second modification of the heating plant have been published. The unit was designed to burn Roslyn Coal from the state of Washington. When operated under the limitations imposed by the design, particularly with reference to the coal used, the generator surpassed the guarantees and expectations. A maximum efficiency of 86.14 per cent was obtained at the continuous rating of 30,000 lb of steam per hr and the subsequent performance of the unit has measured up to that indicated by the test. Unfortunately World War II brought on conditions in the fuel market which made it impossible to obtain the coal which the unit was designed to burn. The University was obliged to accept a wide variety of fuel, much of it entirely unsuited to pulverized fuel firing, and on a number of occasions serious trouble was experienced in attempting to use it for this purpose. The efficiency of the unit dropped below 86 per cent.

In addition to serving the campus heating system the pulverized coal-fired unit has been used as laboratory apparatus for Mechanical Engineering courses, and repeated tests have been run since its acceptance.

When the growth of the campus necessitated additional steam generating capacity, the third modification of the heating plant became necessary. It is with this third modification that the present article deals. It was decided that a spreader type of stoker might be better adapted to the fuel situation existing in Moscow, Idaho. This decision was no reflection upon the pulverized fuel fired generator as such. Accordingly specifications were written calling for furnishing and erecting a steam generator and spreader type

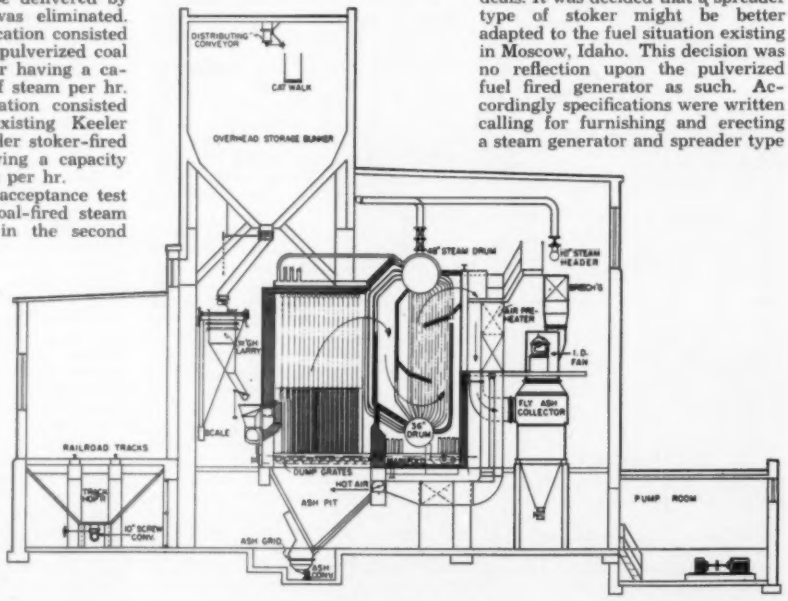


Fig. 1. Cross section of the University of Idaho Steam Plant showing a longitudinal section of the new 40,000 lb per hr, spreader stoker fired steam generator

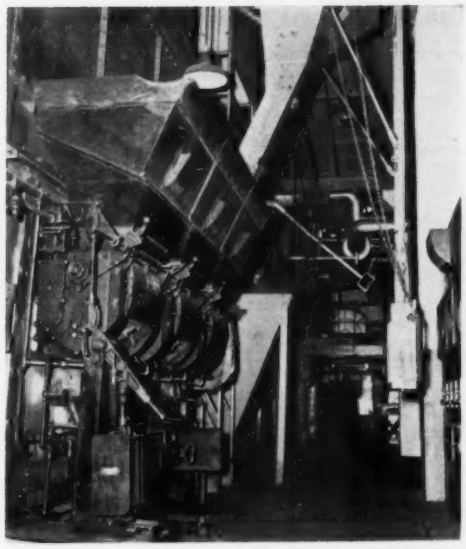


Fig. 2. (Left) Photograph of the front end of the new boiler showing the stoker and the coal handling larry

Fig. 3. (Below) View of the heating plant building. The concrete superstructure houses the overhead coal storage bunker. Raised portion of roof to accommodate new boiler shown at right

of stoker capable of delivering 40,000 lb of saturated steam per hour at a pressure of 160 psig. This steam was to be used primarily for heating the campus buildings; however, a substantial part was to serve cookers in dormitory kitchen and experimental apparatus in Mechanical and Chemical Engineering Laboratories. Included with the steam generator were a cinder collector and fly ash recovery fan, the necessary steam and feedwater piping, an overhead bunker with distributing conveyor and elevator, a two-roll coal crusher, a traveling weigh larry, and a steam-jet ash ejector and ash storage bin with all of the appurtenances necessary for their satisfactory operation.

Two existing horizontal Keeler water tube boilers, one a single drum 2500 sq ft unit, the other a double drum 3000 sq ft unit, were to be removed to make room for the new steam generator. It was decided to allow a 5000 sq ft 4-drum Sterling water-tube boiler to remain and hand fire it for emergencies only. Extensive alterations in the building housing the existing heating plant were necessary to accommodate the new steam generator, with its steam and feedwater loops, overhead bunkers, distributing screw conveyor, elevators, unloading hopper and crusher. The ash storage bin was to be so located that the ashes could be spouted into trucks and hauled away. Separate space was to be provided for boiler feed pumps, an air compressor, and a Buda 25-kw 208/120-v, 3-phase a-c Diesel generating set to be used in case of power failure.

Coal is delivered to the plant by rail in standard dump bottom cars. The coal shed is integral with the heating plant building and extends along the west side. The length of the coal shed was to be increased so that two 50-ton cars could be spotted and unloaded simultaneously. The unloading hopper in the coal shed terminates at the pulverizer room and has a capacity of 125 tons. Beneath the unloading hopper and extending along its entire length is a screw conveyor. Gates are arranged at intervals so that coal from the unloading hopper can be admitted to the conveyor and transferred to the boot of an elevator which in turn would deliver it to an overhead bunker. No extensive alterations were required in the arrangement of the coal shed, with the exception of an increase in its length, the installation of a coal crusher,

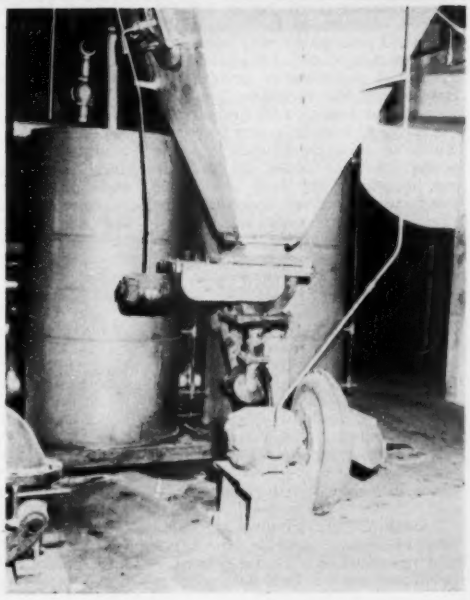


Fig. 4. A view of the fly ash removal fan in the basement. This fan also reinjects the fly ash. The value of this fan as far as boiler efficiency is concerned is questionable but investigation is still under way.

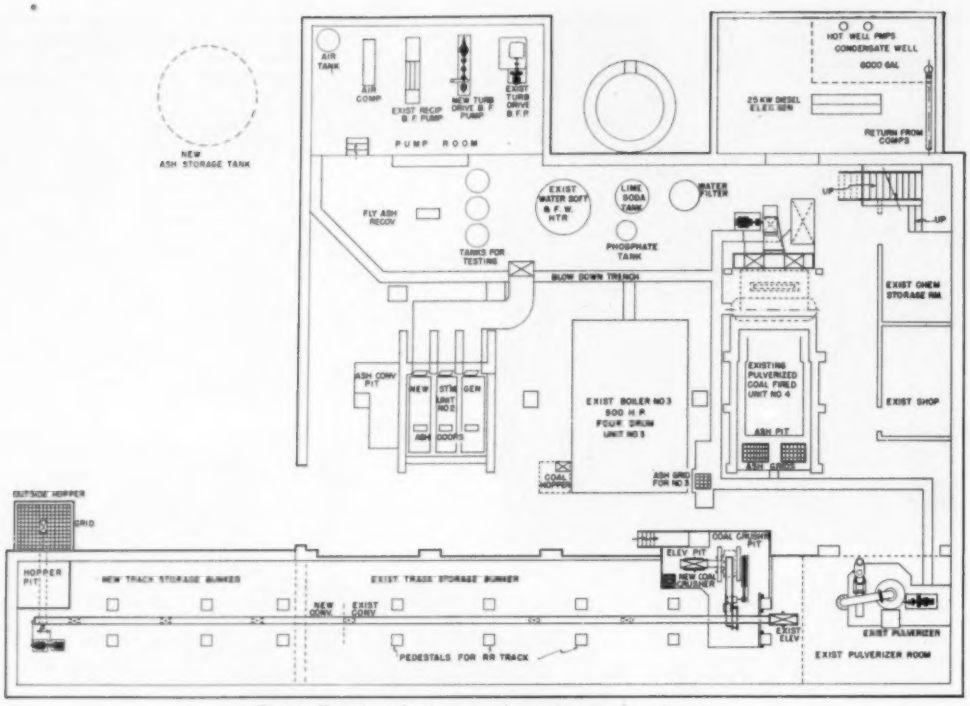


Fig. 5. Plan view, showing general arrangement of equipment

an elevator arranged to deliver coal to the new overhead bunker, and the extension of the screw conveyor to enable it to receive coal from outside storage. The latter was accomplished by providing an outdoor hopper adjacent to the end of the coal shed into which coal from outside storage could be pushed by means of a bulldozer or dumped from a drag line conveyor. The bottom of the hopper was designed to discharge to a 10-in. screw conveyor which in turn discharged into the screw conveyor under the unloading hopper in the coal shed. The overhead bunker was specified to be of concrete construction and located above the front end of the steam generators extending from within 8 ft of the north building wall to the existing pulverized fuel fired boiler, a distance of 44 ft. The capacity of the bunker was to be 400 tons and a screw conveyor was to be located on top receiving coal from the elevator and distributing it uniformly throughout the bunker. In addition to the storage space provided by the bunker and unloading hopper, outside storage space, having a capacity of 2000 tons, was provided. This space is located north of the plant and parallel to the railroad spur.

Lincoln Bouillon, consulting engineer of Seattle, prepared the plans and specifications. Space was at a premium and its lack gave rise to the only difficulties attending the project.

The work was executed under three separate contracts. One contract included the erection of the concrete bunker, modification of the unloading car shed, the pump room, the auxiliary power plant room, cat walks and miscellaneous structural steel work. The second contract included the furnishing and installing of a boiler feed pump, steam headers and fittings, coal conveyors, elevators, coal crushers, and ash handling equipment and all electrical and plumbing work. The third contract included the removal of the old Keeler boilers and stokers and furnishing and erecting the steam generator and spreader stoker with all appurtenances pertaining directly to them. The C. B. Laugh Construction Company of Boise, Idaho, was awarded the first contract. Wyatt & Kipper with headquarters in Seattle, Washington, was awarded the second and third contracts. They bid on furnishing a Combustion Engineering Co.'s type VUH two-drum water tube steam generator, a Combustion Engineering Co.'s SPR spreader stoker, a Bailey instrument panel and control board, steam turbine driven Clarage forced and induced draft fans, a Goulds centrifugal boiler feed pump driven by a Westinghouse steam turbine, a Fairbanks-Morse weigh larry, a Marion Machine and Supply Co.'s 2-roll crusher, a United Conveyor Corp. steam jet ash ejector and the steam headers, plumbing, and electrical work, all in conformity with the plans and specifications.

The steam generator, as installed, occupies a basement and three galleries. The basement gives access to the ash pit for cleaning and the operation of the steam-jet ash ejector with inlets in the ash pit. In the basement and at the rear of the steam generator, the fly ash recovery fan and tanks for testing are located.

The first gallery extends entirely around the setting and forms the main operating floor. From this gallery the stoker controls, coal weigh larry, blowers, boiler blow-down valves, and hand chains for regulating the boiler feedwater valves are accessible.

The second gallery extends along the south side and rear of the setting. The portion at the rear supports the forced draft and induced draft fans and provides access to them.

The third gallery extends along the south side only of the setting and provides access to the top drum, the safety valves, steam header and water column. The cat walk under the steam main is entered from this

(Continued on page 128)

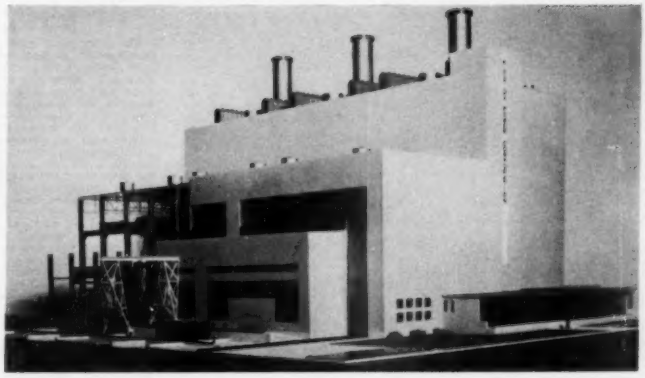


Fig. 1. Model of Booth Point plant of Florida Power Corp., made by Woodcote Associates

Models made by Woodcote are of wood, metals and plastic. This model-maker uses mass-production methods for window frames, stairways, gratings, siding and the like, for uniformity and low cost. Has built desk models to scale as small as 1/40 in. to foot. Publicity models are 1/16 to ⅛ in. to foot. Detailed engineering models ¼ to ½ in. to foot or larger. Recently made one showing all piping down to 2 in. at ½ in. to foot.

Larger models have transparent walls, floors, turbine foundations, so auxiliaries can be properly located. Small models cost, in 1950, from $300 to $1000, larger ones $3000 or more and we have heard of very elaborate ones costing up to $50,000.

In large consulting firms, teams of men work on design of different parts of plant and can co-ordinate their efforts by means of the model.

Models Cut Power Plant Design Costs

FOR A GOOD MANY YEARS, use of power plant models has been growing in importance as a most effective tool for reducing the costs of power plant design. It is true that, in many cases, models of completed plants have been made only for exhibition and public relations purposes. But more and more frequently they have been used for strictly engineering purposes, right from the inception of plans for a specific plant. Although engineering models have been built mostly for design of central stations, there is no reason why the same ideas cannot be similarly used in industrial power plant work.

One of the earliest uses of detailed working models was by The Detroit Edison Company about 25 years ago. The company has always continued to use models, one of the latest being the Conners Creek coal-handling model, February, 1951 issue, page 83.

Types of Models

Models of power plants are today of three general types and with general uses as follows:

1:—Block models, usually small-scale and simple, to give a general impression of the plant for preliminary layout, relative layout of components, arrangement of extensions to existing plant and the like. This is very useful for both designer and client.

2:—Detailed model of completed installation, like Fig. 1, giving better idea of installation than drawings or even architect's perspective, which it can supplement. This model is particularly effective in demonstrating features of the proposed plant to non-technical boards of directors and financiers. It can afterwards be displayed to the general public and used for reference by the designer.

3:—Working model containing all equipment and piping layouts to fairly large scale. In modern high-pressure, high-temperature plants, such a model often precedes completion of finished drawings and piping layouts. In such plants, large sections of the high-temperature piping may be prefabricated by the piping manufacturer and it is practically impossible to modify them in the field. Hence, on the model, such as that of Fig. 2, equipment layout and piping interferences, lighting, accessibility for operation and maintenance, and the like, can be conveniently studied and checked and the final drawings can be made accordingly, with much saving in drawing costs.

How Models Cut Costs

It must be remembered that models cannot replace the designer's final drawings, many copies of which must be part of the specifications for equipment manufacturers and field erection men.

Use of models incorporating standardized components in various combinations to form several different plants was a recent interesting use, and one which cut design costs materially. This was done by making models of preferred standard turbine generators and standard boilers, with their auxiliaries, and combining them in three ways to determine designs for three outdoor power plants: Hamilton Moses plant; Nine-mile Point plant; Natchez Steam-Electric Station.

In the design of Sewaren Generating Station, a problem of proper aircraft warning lights for the stacks was quickly solved, to the full approval of the CAA, by scale models of the lighting equipment installed on the stacks of the model.

Models have been made—or more properly, "mock-ups"—of centralized control boards, which could be modified to fit conditions.

Practically every leading consulting engineering firm in the country is using power plant models in the ways indicated above.

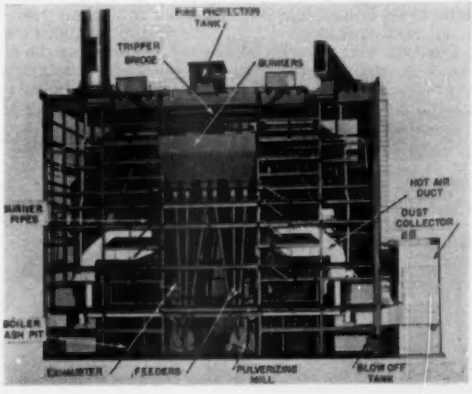


Fig. 2. Portion of detailed working model of Sunbury Steam-Electric Station, Pennsylvania Power & Light Co. (See *Power Engineering*, November, 1950)

This portion of model shows details of steam generating equipment and auxiliaries. Other portions show details of turbine generators, control room and the like. Model proved very useful in eliminating interferences and undesirable features, in studying illumination and locating smaller auxiliaries and controls.

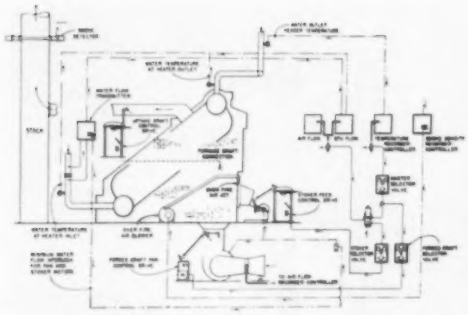


Fig. 1.—Left. Combustion control for water heating boiler in plant of Bailey Meter Co., as shown in Fig. 2

To determine heat liberation for records and as a guide in combustion control, novel Btu flow meter is utilized. This measures water flow through boiler and temperature rise, and automatically computes and records total Btu delivered by the boiler. This Btu flow is compared against air flow for combustion in exactly the same way that the steam flow-air flow is used in controlling combustion on standard steam boiler. Also interlock provided on water flow measuring element, which shuts down stoker and the forced-draft fan in case of failure of water supply.

Combustion control with parallel control of stoker speed and forced-draft air supply in accord with load, which is indicated by measurement of water temperature instead of steam pressure as on standard steam boiler. Stoker speed readjusted automatically from Btu-flow air-flow recorder controller to maintain proper fuel bed and best combustion with minimum excess air.

Control of uptake damper from independent furnace draft regulator. On such small boilers, where it is difficult to maintain tight furnace settings, such a regulator is a must to avoid air infiltration losses, protect operators in inspection, fire cleaning.

Flue gas temperature record, added to Btu-flow-air-flow recorder for determination of cleanliness of boiler; and combination draft gage indicates windbox pressure, furnace draft and uptake draft, provides guide to air pressure losses throughout boiler.

Fig. 2.—Right. Firing aisle of the Bailey Meter Company's small heating plant

Advantages of this type of plant:

1. Equipment simple to operate, easy to maintain. Reliable performance can be expected from plant of this type.

2. Plant has very wide load range; with spreader or underfeed stokers is quick to respond to load changes and can be operated very efficiently under fluctuating loads.

3. Where plant must be brought to substantially no load, relatively easy to stop and start unit and carry it on bank, giving extreme load range without complication.

4. Through use of smoke recorders and automatic control of overfire air jets, clean fires can be maintained and smoke avoided, particularly important in urban areas.

5. Plant of this type requires only part time supervision; other duties can be assigned to operating personnel.

By P. S. DICKEY,
Bailey Meter Co.

Small Power Plants, Too, Can Afford

OBJECTIVES IN applying instrumentation and automatic control to the small power plant, identical with those for large industrial or central station power plants, are: 1. To improve fuel economy; 2. To keep over-all costs at a minimum; 3. To insure safe and reliable operation; 4. To utilize operating personnel efficiently.

Four small plant classifications are: 1. Small coal-fired boilers; 2. Small oil-or gas-fired boilers; 3. Medium-sized boilers for industry; 4. Small central stations.

Domestic and commercial heating plants generally of 100 hp and less, are not discussed because the quantities of fuel burned hardly justify extensive instrumentation and automatic control.

Control and Instruments for Small Coal-Fired Boilers

Many boilers are in the capacity range of 5,000 to 30,000 lbs of steam per hour or equivalent heat liberation on which intelligent application of instruments and control can guarantee savings equal to 20 per cent or more of the cost of the control equipment and at the same time provide much improved performance in meeting the demand on the plant. These plants generally provide heating and industrial process steam, at medium pressures. Coal is burned because of cost or because of the proximity or reliability of supply. Mechanical stokers of the spreader, underfeed or chain grate type are almost invariably used in this type of plant today.

Since author's company has had first hand experience with operation of a plant of this type for heating its own factory and since the installation has more than justified expectations as to performance, he described it in detail in this paper before the 13th Midwest Power Conference, as abstracted here.

Figure 1 shows arrangement of instruments and control for the 250-hp boiler fired by a single-retort underfeed-type stoker in our plant. The building heating system utilizes hot water and no process steam is required, hence a standard water-tube boiler with minor modifications necessary for hot water heating is used. Controls are as described beside Fig. 1.

Our problem was similar to many plants of this character; building clearances limited height of boiler setting, thus prevented ideal furnace arrangement. To achieve smokeless combustion with low excess air, we

Automatic Controls	*To Maintain*
Combustion	Steam Press-Combustion Eff-Furn. Press.
Feedwater	Drum Level-Uniform Feed Supply
Feed Pumps	Feedwater Pressure
Recorders	*To Record and Check*
Steam Flow	Total Steam Generation
Steam Flow-Air Flow	Combustion Efficiency
Steam & Water Temp.	Heat Balance
Flue Gas & Air Temp.	Boiler Efficiency
Drum Level	Feedwater Regulation
Feedwater Flow	Total Water Consumed
Steam & Water Press.	Regulation
Oxygen Analyzer	Combustion Conditions
Smoke Density	Combustion Conditions
Conductivity and pH	Steam and Water Purity
Indicators	
Steam and Water Pressures	Oil Temperatures
Fuel Pressures	Speed Indicators or Ammeters for
Air Pressures and Drafts	Fans, Pumps, Feeders, etc.

Check list of instruments and automatic controls that should be applied to medium-sized steam plants in the capacity range from 30,000 to 200,000 lb per hr or more. Special problems require special equipment, but those listed can be economically justified for practically every medium-sized power plant

Fig. 3.—Right. Here is a typical "package" water-tube boiler for oil and gas firing

Forced draft fan, fan damper controls, feedwater regulators, burner protective equipment, soot blowers, etc., assembled to boiler in factory.

Control panel contains necessary instruments, combustion controls, burner lighting and safety controls, main fuel regulating and shut-off valves, controls for ignition torch and for atomizing steam for oil burners.

Oil pumping set may be installed in control panel. For heavy oils, complete fuel oil heating unit with automatic control may be likewise installed.

Panel comes completely assembled, piped and wired from factory and minimum of field connections required for plant. Instruments include main pressure gage, steam flow and air flow meter if desired, flue gas temperature recorder and fuel windbox pressure indicators.

Advantages of this type of plant:

1—Nearly complete factory asembly reduces field installation costs to a minimum.

2—Designed and controlled for efficient and smokeless combustion over 4-to-1 load range, burning either oil or gas.

3—Low loads and banked condition carried by off-on control of burners.

4—Complete control system with safety interlocks and warning devices eliminates need for full time attendance.

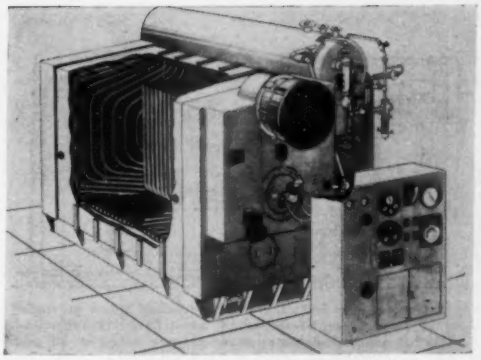
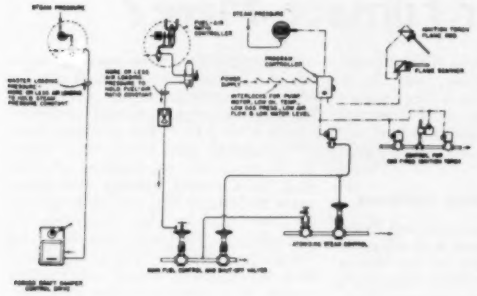


Fig. 4.—Left. Combustion control for "package" boiler of Fig. 3



Steam pressure regulates forced-draft air supply by regulating forced-draft fan inlet vanes. Metering-type fuel-air ratio controller regulates fuel in accordance with combustion air supply. Designed for pressurized operation at low values of excess air, substantial fuel savings possible, so close control provided. Savings up to 5 per cent or more of total fuel bill possible, enough to pay for control equipment quickly.

Full throttling control of the fuel and air supply is utilized over 4 to 1 operating range of burners. However, to extend range of operation below the minimum combustion rate, burners started and stopped in accordance with steam pressure changes, which permits operation down to substantially no load. Firing rate is low; the control may be adjusted to maintain steam pressure within reasonable limits without excessive cycling of start and stop controls.

Protection against low water in drum, loss of forced-draft fan or fuel pumps, or loss of ignition, included with off-on control system, arrangements may readily be made to signal operator in case of failure due to any of these causes. This type, therefore, does not require full time supervision since it is fully automatic, fully protected against failures of auxiliaries, provisions can be made for audible alarms.

Good Instrumentation and Control

found overfire-air jets very beneficial, particularly during fluctuating loads. A smoke recorder with automatic control of start and stop of the overfire-air fan from smoke density has been of extreme benefit in achieving smokeless combustion with low excess air and in conserving overfire-air fan power by utilizing the air jets only when necessary. The recorder is also a valuable guide to the firemen in keeping fires in proper condition.

Our experience has indicated that a plant provided with this equipment will operate efficiently without need of highly-trained personnel. Figure 2 shows the general arrangement of this plant, and its advantages are noted in the caption.

Control for Package-Type Oil and Gas Fired Boilers

These boilers are built by a number of manufacturers in sizes ranging up to 30,000 lb per hr of steam. They are designed for complete factory assembly and may be shipped assembled to the customer's plant. The boiler furnace is designed for pressure operation so that the forced draft fan supplies the required amount of air for combustion regardless of stack draft available. Figure 3 shows a plant of this type and Fig. 4 the arrangement of its combustion controls.

Medium-Sized Steam Plants for Industry

Many industries require process steam in amounts varying from 30,000 to 200,000 lb per hr and upward. Turbine generators may or may not be included, depending largely upon possibilities of utilizing extraction steam for process. Each plant has its own particular problem: varying process steam requirements, pressure and temperature, necessity or desirability of burning different fuels, including waste fuels.

Trend, however, is towards fewer boilers and units of higher capacity to reduce over-all costs and supervision. Boilers are usually equipped with economizers or air preheaters for maximum heat recovery. Because high pressure and temperature and large quantities of feedwater

(Continued on page 124)

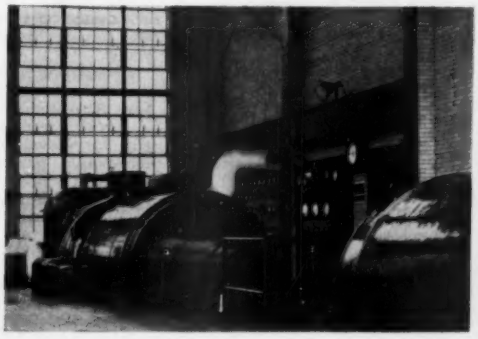


Fig. 5. One of earlier small utility plants in which controls for boilers and turbines were centralized. It is Iowa Falls Station of Central States Electric Co., put into service in 1943. Unit shown consists of one 12,000-kw turbine generator, supplied by one 125,000-lb-per-hr, 420-psi, 750-F, spreader-stoker-fired steam generator. Combined boiler and turbine control panels at right rear

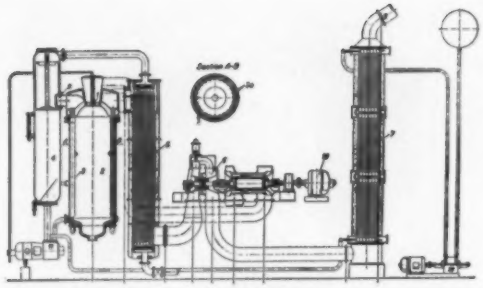


Fig. 1. Probably the first commercial pressurized steam generating unit, the Velox boiler, developed by Brown Boveri in Switzerland. Combustion chamber operates under pressure of 30 to 50 psig, burning oil. Many units installed abroad

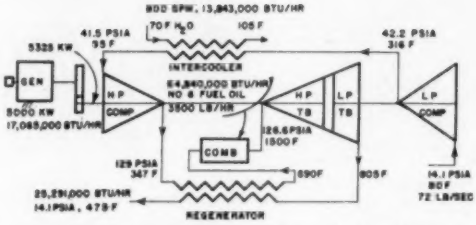


Fig. 2. Another form of pressurized furnace is the combustor of the gas turbine. This is schematic diagram of 5000-kw GE gas turbine electric generating unit installed at Edward M. Graham Station. Combustion chambers operate at about 127 psia

Is the Pressurized Boiler Furnace Here?

TO HELP YOU arrive at your own answer, here is some recent information about pressurized furnaces actually in operation, to show where the development stands at this moment.

The idea of burning fuel in combustion chambers under pressure is not new, by any means. For many years it has been discussed pro and con by power engineers and it has been used in a variety of ways. It is only within the past 4 or 5 years, however, that furnaces of stationary steam generating units have been pressurized and it is this type of pressurizing this article will discuss. You understand, of course, that when we speak of pressurizing the furnace, that means the entire boiler enclosure, from burners to boiler exit, is under air pressure instead of draft. The combustion gases are "pushed" through instead of being "sucked" through. Reason:—to increase rate of heat transfer between gases and water in tubes.

Box Score

First let's look at the box score, as of this writing:

1. Cyclone-furnace-fired boilers, fired with crushed coal (not pulverized), many designed for operation of entire boiler under pressure. At this writing, 54 cyclone-furnace units firing 22 steam generating units are either in operation, soon to go in operation, or on order.
2. Approximately 25 oil-and-gas-fired units installed or on order, with no induced-draft fans, and designed for pressure operation.
3. Pulverized-coal-fired boilers at Sporn and Twin Branch Stations, capacities up to 930,000 lb per hr of steam, designed for pressurized operation, although not yet so operated, for reasons given later. AG & E has installed or on order 11 such units or larger.
4. Knox Lee Station has two 300,000 lb per hr natural gas fired units in operation under pressure.
5. First 250,000-lb-per-hr gas-fired pressurized units now in operation at Quanah Station.
6. Two boilers of 200,000 lb-per-hr capacity, burning natural gas and designed for pressurized operation, ordered by a southern chemical company.
7. Announcement, by several manufacturers, of small water-tube "package" units from 10,000 to 30,000 lb steam per hour, designed for pressurized operation.

That general picture may change between now and press time. Up to March, 1951 only one boiler manufacturer's pressurized units were actually in operation and news of the others was received by us after that date.

How Pressurized Firing Developed

Background for pressurized firing was given by Professor A. G. Christie (Ref. 1, list, page 83) in the March 1945 issue of *Power Plant Engineering* (now POWER ENGINEERING). Professor Christie reviewed at that time the fact that there were practical limitations on further lowering of final flue gas temperatures and furnaces were becoming very large, requiring large boiler rooms. (This has since been cancelled out in some cases by outdoor construction.) But even more important, weights of metal in the boiler, auxiliary power requirements and other factors made it desirable to develop a smaller steam generator for high efficiency.

One attempt to achieve this was introduction of forced circulation of boiler water. To get smaller furnace volumes, heat releases would have to be increased. Dr. Christie reviewed development of the Velox boiler abroad, involving operation at furnace pressures of 25 to 40 psi and forced circulation of the boiler water.

Pressurized firing in marine steam generating units has long been popular. Also, about 12 years ago several forced circulation boilers, primarily for Naval ships and railroad locomotive propulsion, were built with spot welded and insulated casings for pressurized firing.

Other forms of pressurized combustion chambers are, of course, the internal combustion engine and, in recent years, the gas turbine combustor. The latter operates at pressures as high as 129 psia, as in Fig. 2. Heat releases in oil-fired gas turbine combustors have reached values of 2,500,000 Btu per cu ft per hr and, in airplane work, sometimes higher. However, recent experiments with pulverized coal combustors indicate that more time must be allowed for combustion of coal and, as a result, energy liberation rates of 500,000 Btu per cu ft per hr or lower may be more desirable.

Professor Christie reviewed the foregoing situations and pointed out that since more rapid combustion occurs in a furnace under pressure, it had many advantages in decreasing boiler volume and metal, eliminating the induced-draft fan, reducing auxiliary power and so on, although there would be little increase in steam generator efficiency.

Since his article was written, a great deal of work has been done and the above tabulation at the beginning of the article shows the practical results achieved thus far in pressurizing the stationary boiler furnace.

Many of the operating details have recently been reviewed; in June 1950 by Welsh and Skog (Ref. 9) and by Mackenzie, March 1951 (Ref. 10).

What Pressurized Firing Does

Advantages claimed for pressurized firing, to help in reducing the cost of a kilowatt hour, are somewhat as follows, according to Mackenzie:

1. **Increase in boiler and furnace efficiency** because infiltration of air is eliminated and large part of compression energy that would go to stack from induced-draft fan is recovered.
2. **Decrease in maintenance cost** through elimination of the I-D fan (important in a coal fired job where it is primary source of maintenance and sometimes outage). Also, if casing is against back of tubes, it is at saturation temperature and possibility of dewpoint corrosion on inside of casing is eliminated. Also, if insulation is outside casing, deterioration through sulfur-bearing gas is avoided.
3. **Increase in reliability** by elimination of I-D fan with all its attendant control equipment. Another gain is reduced hazard of furnace explosions

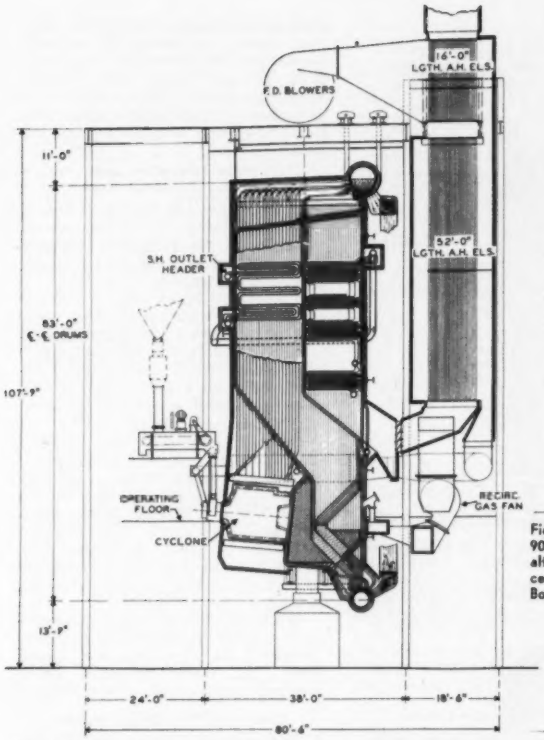


Fig. 3. Cross-section of one of recent cyclone-furnace-fired steam generating units, for pressurized operation, soon to be installed (Courtesy The Babcock & Wilcox Co.)

Capacity 475,000 max. cont., 1850 psi, 1000 F, reheat to 1000 F, to be fired with crushed West Virginia coal by two 9-ft dia cyclones. Design efficiency 89.6 per cent. Furnace pressure in units of this type is about 40 in. H_2O in the cyclone, 15 to 25 in. H_2O in primary and secondary furnaces.

traced to forced and induced-draft fans being out of phase.

4. **Decrease in auxiliary power** by approximately one-third, since all air is handled cold by F-D fan and total amount of air is reduced.
5. **Reduction of initial cost** by elimination of induced draft fans and attendant drives, controls, connections and foundations, plus corresponding saving in building volume. These savings generally more than offset added cost of pressurized casing, ash hopper and appurtenances, and added cost of high-pressure forced-draft fans and drives.

Cyclones Under Pressure

In the cyclone-furnace unit, all air is supplied by forced-draft fans or blowers, discharging at approximately 80 in. H_2O. In one installation, these blowers are of the axial-flow type; in another they are centrifugal blowers; and in the installation shown in Fig. 4, a still newer type of axial blower, Fig. 5, has been employed. In others, conventional designs of fans or blowers are used.

Pressure drop across the cyclone furnace itself is in about 35 to 40 in. of water and in burning crushed

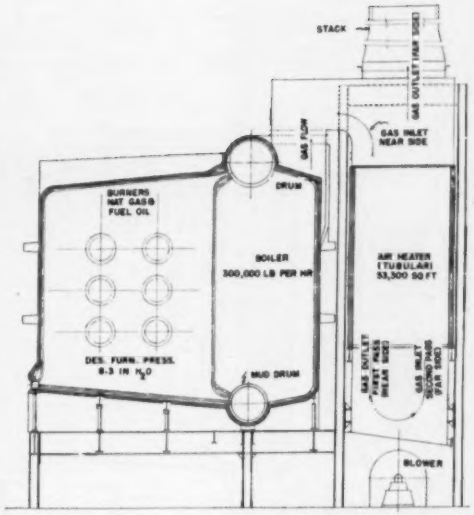


Fig. 4. Cross-section of one of two 300,000-lb-per-hr, 875-psi, 905-F steam generating units, for pressured firing with gas, oil alternate, provision for future pulverized coal, now operating successfully at Knox Lee Plant of Southwestern Gas & Electric Co. Boiler operates with about 8 per cent excess air (Courtesy The Babcock & Wilcox Co.)

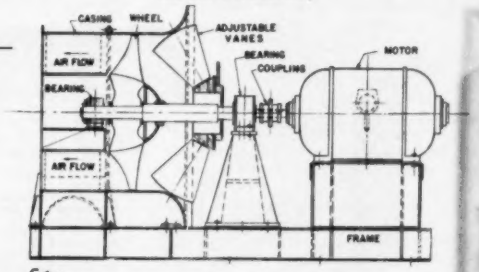


Fig. 5.—Right Center. Combustion air for boiler of Fig. 4 is supplied by cast aluminum axiflow fan, motor-driven, first time used in stationary plant. Delivers 76,000 cfm at 16.2 in H_2O static at 100 F (Courtesy Sturtevant Div., Westinghouse Electric Corp.)

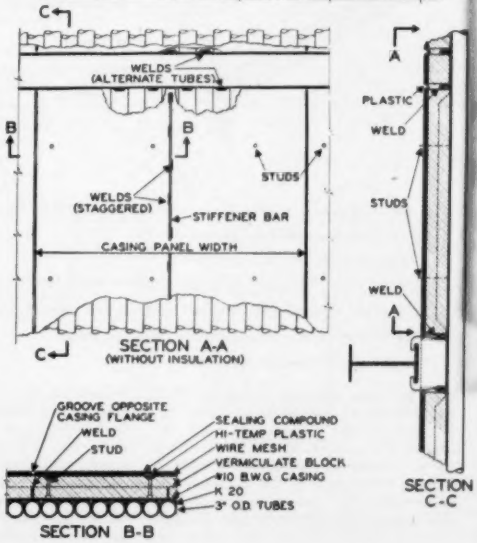


Fig. 6. Arrangement of elements of one type of casing for pressurized boiler, close spaced wall. Note how panel flange and toe of channel meet at angle and are welded at toe. This allows for some expansion when starting up boiler, provides for temperature differential of 150 F; measured differential only 60 F (Courtesy The Babcock & Wilcox Co.)

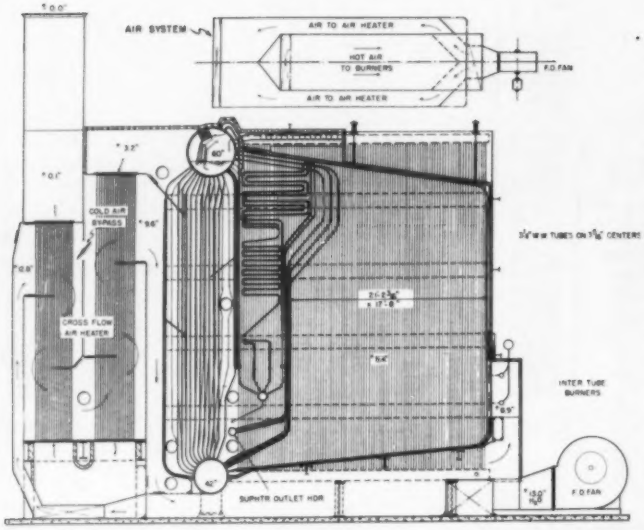


Fig. 7. Recent design of pressurized steam generating unit, one of two to be installed outdoors in a chemical company's plant (Courtesy Riley Stoker Corp.)

Capacity 200,000 lb per hr, 1000 psig, 850 F, natural gas firing, (auxiliary oil). Forced-draft fan discharge pressure 13.0 in. H_2O, furnace pressure 5.4 in H_2O. Entire structure built to withstand internal pressure of 20 in. H_2O = 100 lb per sq ft. Design efficiency 83.1 per cent. Details of construction of boiler casing in Fig. 8.

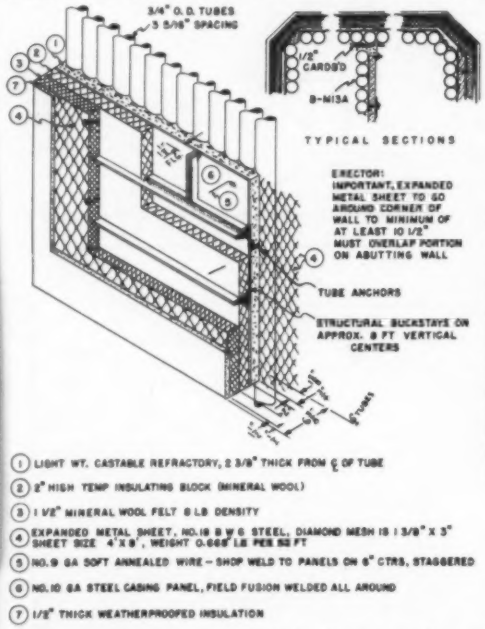


Fig. 8. Details of casing construction for Fig. 7 boiler. (Courtesy Riley Stoker Corp.)

Over outside of tubes, expanded metal sheet 4 is tack welded to support castable refractory 1. Covering that is 10-gage steel skin 6, formed of panels welded to each other and to horizontal channel buckstays. These surround furnace, are anchored to tubes by welded clips. Over them and skin, block and felt insulation and final weatherproof insulation. No outside steel casing. Minimum of openings through setting.

coal in these cyclone furnaces (Ref. 8), details of which have been described in the literature, heat releases of as much as 400,000 Btu per cu ft per hr are attained. Combustion is completed in the cyclone furnace and the hot combustion gas discharges into primary and secondary furnaces, where the heat releases are of more conventional values: somewhere between 20,000 and 35,000 Btu per cu ft per hr. By the time the flue gas gets into the primary and secondary furnaces, it is under a pressure varying between 15 and 25 H_2O. The remaining 20 or 25 in. H_2O air pressure is available to force combustion air and gases through ductwork, convection and superheater sections of boiler, reheater section, if one is installed, then through large air heaters, sometimes divided into primary and secondary sections. There may also be primary and secondary economizers.

Heat Liberation and Furnace Pressures Used

In the Knox Lee boiler of Fig. 4, heat liberation is 31,200 Btu per cu ft per hr at rated capacity burning gas, and furnace is designed to operate at approximately 8.3 in. H_2O.

Blowers for Knox Lee, Fig. 5, are single-stage 7-bladed axiflow type, first of this type to be installed in a stationary plant, although originally designed for Naval vessels. They are equipped with a sound trap to reduce noise level; fan room is paneled with acoustical material.

Furnace pressures for smaller units, such as that of Figs. 7 and 11, are of course lower in proportion because of the smaller size of the units. These pressures, in the plant of Fig. 7, beginning with the fan discharge pressure of 13 in. H_2O, range through the values as shown on Fig. 7. In the furnace itself, the pressure is 5.4 in. H_2O.

"Package" unit of Fig. 11 operates with a furnace pressure of approximately 3 in. of water, the forced draft fan outlet pressure being generally between 5 in. and 10 in.

Details of Pressurized Boilers

The unit of Fig. 11 has a completely seal welded casing, designed so that sections can be removed. No refractory is used except tiles on the furnace floor tubes and tiles in the first boiler baffle. The enclosure is otherwise of double-cased construction with insulation between the casings. The latter is arranged on the outside of the closely spaced tubes, and any tube can be removed without removing any others. Observation doors on Fig. 11 unit are of the screw-down type for pressure tightness.

The wall construction for the boiler of Fig. 4 at Knox Lee plant is described in detail in Ref. 9.

On the Knox Lee forced-draft axial blower, the wheel was constructed of cast aluminum, heat treated and dynamically balanced with flow vanes in the discharge to straighten out the tornado spin, and insure uniform flow and duct velocities. The units have self-aligning ball bearings and are driven by 500-hp motors.

The boiler units shown in Fig. 7 will operate at 1000 psig and 850 F. The principal fuel will be natural gas but they will also burn residue gas and will be equipped to burn oil as auxiliary fuel. Efficiency will be 83.1 per cent when burning gas at design output rate. On these units air pressure at forced-draft fan outlet is 13.0 in. The entire structure will be built to withstand 20 in. H_2O air

Table I. Basis for a typical evaluation on a reheat steam generating unit (Courtesy S. T. Mackenzie and B & W)

EVALUATION PC, PRESSURE AND SUCTION ASSUMED BASIS FOR EVALUATION	
475 000 LB/HR REHEAT	1600 PSI 1000 F 1000 F
DEMAND CHARGE	$150/KW
CURRENT CHARGE	.31¢/KW
FUEL COST	34.9¢/MILLION BTU
HEAT RATE	9200 BTU/KW HR NET
RETURN ON INVESTMENT	10%
HOURS/YR	7000
ELECTRIC EQUIPMENT FOR	
LARGE MOTORS	$5000 EACH
FAN FOUNDATIONS	$3000 EACH

Table II. Comparison of base cost and capitalized operating cost for plant of Table I (Courtesy S. T. Mackenzie and B & W)

EVALUATION PENALTIES PC FIRING - PRESSURE VS SUCTION		
1. OPERATION	PRESSURE	SUCTION
POWER	—	$28,500
EFFICIENCY	—	69,000
MAINTENANCE	—	7,600
TOTAL	—	$107,100
2. CAPITAL EXPENSE	PRESSURE	SUCTION
DIFFERENCE IN COST OF STEEL CASING (ERECTED)	$84,000	—
DEMAND CHARGE	—	$30,000
INSTALL MOTORS, FAN	—	10,000
FAN FOUNDATION	—	3,000
DIFFERENCE IN COST OF FANS AND DRIVES	—	4,200
	$84,000	$47,200
GRAND TOTAL	$84,000	$148,300
		−84,000
NET PENALTY AGAINST SUCTION		$ 64,300

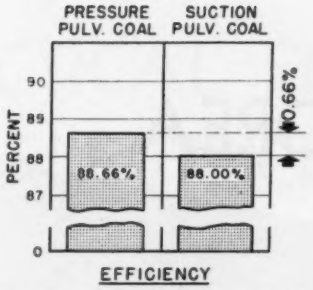


Fig. 9. Chart showing difference in efficiency between pressurized and suction type designs for plant of Table I (Courtesy S. T. Mackenzie and B & W)

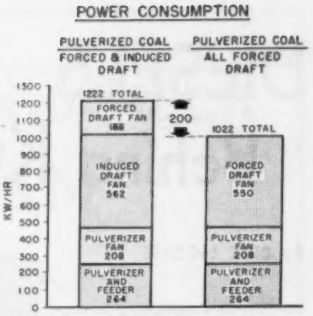


Fig. 10. Chart showing difference in full load power requirements for pressurized and suction designs for plant of Table I (Courtesy S. T. Mackenzie and B & W)

pressure, equivalent to 100 lb per sq ft.

The boiler units of Fig. 7 will be installed outdoors and will be completely weatherproof but will have no outside steel casing. Figure 8 gives details of the casing construction of the boilers of Fig. 7. All access doors are circular, designed to be locked and tight under the furnace pressure. They cannot be opened with the boiler in service, they are actually padlocked. These boilers of Fig. 7 will be fired with a new design of intertube burner.

Small Pressurized Boilers

Other small pressurized furnace boilers of from 6000 to 25,000 lb per hr were also supplied by this same manufacturer during 1935 and 1936 for use in oil refineries. The settings were built to withstand internal pressure of about 1½ psig because some of the boilers are used in connection with processes from which waste gases are discharged at nearly 1 psig.

In addition to the very large and moderately sized units described here, at least one of the small firetube multi-pass "package" boilers now on the market operates with the furnace under pressure (Ref. 13). For the units of this type in operation, average value of furnace pressure is 3½ to 4 in. water, although the range is from 3 in. to 5 in. and in normal current designs is running around 3 in. and under.

Detailed discussion of operating problems and their solution on the first of the three cyclone-fired steam generating units of the Dow Chemical Co. and the way the operating experience with this unit would be applied to the design of the second and third units, was given by Merle Newkirk in an ASME paper (Ref. 14).

Problems in Pressurized Casings

Problems in design of casings and inspection doors, soot blower openings and other parts of the enclosure arise in a pressurized boiler. Most of these problems have been successfully solved in most of the pressurized installations, although in one or two they have not.

Figure 6 shows a successful pressurized boiler casing applied by one manufacturer (Ref. 10). With an outside welded casing, there would be a very high temperature differen-

(Continued on page 142)

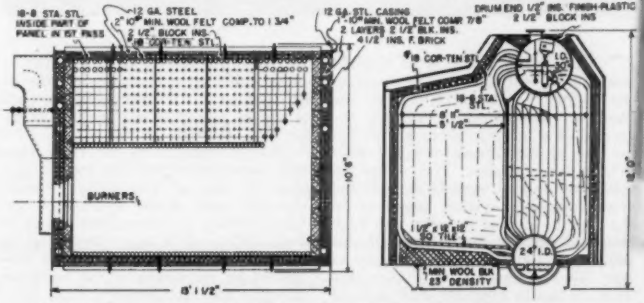

18-8 STA. STL. INSIDE PART OF PANEL IN 1ST PASS
12 GA. STEEL
2" K.P. MIN. WOOL FELT COMP. TO 1 3/4"
2 1/2" BLOCK INS.
18 COR-TEN STL.
12 GA. STL. CASING
2 LAYERS 2 1/2" BLK. INS.
4 1/2" INS. F. BRICK
DRUM END 1/2" INS. FINISH PLASTIC
2 1/2" BLOCK INS
BURNERS
10'6"
8'1 1/2"
24" I.D.
18'0"

Fig. 11. Cross-section of water-tube package units for pressurized operation. (Courtesy Springfield Boiler Co.)

Capacities 10,000, 15,000 and 20,000 lb per hr; pressures up to 600 psi. Supplied completely assembled with all auxiliaries and controls. Furnace pressure about 3 in. H_2O. Casing details in text. This unit designed for installation soon in power plant of automobile manufacturer in Middle West.

References

1—Possibilities of the Pressurized Boiler Furnace; A. G. Christie (then Professor of M.E., The Johns Hopkins University, now emeritus and consulting engineer); *Power Plant Engineering*, March 1945

2—The Velox Steam Generator; Dr. Adolph Meyer, Brown Boveri & Co., Baden, Switzerland; *Mechanical Engineering*; August 1935

3—Firing High-Pressure Furnaces; E. G. Peterson; *Transactions ASME*, July 1944, page 433

4—The Gas Turbine Power Plant; John I. Yellott, Locomotive Development Committee, *Power Plant Engineering*, January 1947 to February 1948

5—First U. S. All-Gas-Turbine Power Plant—The Edward M. Graham Station, Power Engineering, March 1951

6—Dow Installs First Industrial Cyclone Units, *Power Generation*, now Power Engineering, March 1949

7—Dow's South Power Station; *Power Engineering*, September 1950

8—The Cyclone Furnace — Latest Thing in Coal Burning; F. X. Gilg; The Babcock & Wilcox Co., *Power Generation*, now Power Engineering, April 1950

9—Knox Lee Power Plant's Pressurized Furnace; J. Robert Welsh, Southwestern Gas & Electric Co., and L. Skog, Jr., Sargent & Lundy; Semi-annual Meeting, ASME, St. Louis, June 1950

10—Development of and Experience with Pressurized Furnaces; S. T. Mackenzie; The Babcock & Wilcox Co.; paper before Southeastern Electric Exchange Operator's Group, St. Petersburg, Fla., March 30, 1951

11—Riley Stoker Corp.; private communications

12—Springfield Boiler Co.; private communications

13—Cleaver-Brooks Co.; private communications

14—A Cyclone-Fired Pressurized Steam Generator; Merle Newkirk, The Dow Chemical Co., paper before Semi-annual ASME Meeting, St. Louis, Mo., June 1950

DIESELS Behind KOREA

By DICK LaCOSTE

Fig. 1. (Right) View of Funabashi Transmitting Station in Japan. Built in 1913 by German engineers and extended by the Japanese, this station came under the control of the 1956th Airways and Air Communication Service Squadron in 1945

Fig. 2. (Below) A 600-hp Japanese built Diesel engine used to supply power to the Funabashi Radio Station shown in Fig. 1. This 600-kw unit is used to back up the main 675-kw generating unit under emergency conditions

COMMUNICATION is as vital in modern warfare as are many of our highly developed weapons, indeed, communication must be regarded as a weapon since a war can be lost by the breakdown of communication systems. The views on this page show something of the communication system involved in the war in Korea, namely, the high powered radio transmitter at Funabashi in Japan from which many of our air operations are directed. This station is supplied with electric power from a Diesel plant consisting of two Japanese built Diesel engine generators. Both units are rated around 600 kw and generate current at 3300 v. One unit normally supplies the load and the other is maintained as a standby in case of emergency. It is arranged so that it can be placed in service in a matter of 30 seconds.

The photograph of the radio station was taken from the second rest stop of one of the 600-ft towers carrying part of the antenna array. Construction of this station began in July 1913 and it was completed in March 1915. The station was designed by engineers of the Siemens Electric Co. in Germany and construction was started by German engineers. At the outbreak of World War I, however, the German engineers returned to Germany and the Japanese Navy completed construction of the station after they left.

During the period between 1938 and 1942, additional facilities were provided and older types of transmitting equipment replaced with modern types. At that time too, six 600-ft steel towers were erected, and the two Diesel units placed in service. During the war, therefore, this station and these generators operated against our interests.

In October 1945, when our forces began to occupy Japan, operation of the station was assumed by the Airways and Air Communications Service Squadron and then transferred to the Ministry of Communications.

The Funabashi Station is one of the most important transmitters in Japan, today, as far as our air operations are concerned. Many of the planes which shuttle back and forth between Japan and the United States over the Arctic Circle route tune in on this transmitter on their final leg to Japan. The weather in this part of the world can be bad and it is essential that the planes have an unfailing source of radio signals by which to guide them safely to their destinations. For this reason, it is extremely important that this high power station provide reliable service 24 hours a day, seven days a week.

Thus, these Diesels, once operated by our enemies in the terrible war against us, now help to guide our pilots in the conduct of a new and different kind of a war against a different enemy.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

QUESTIONS & ANSWERS

Among the many aspects of our jobs as editors that keep us from becoming bored with life is the wide variety of questions that we receive from readers. If, at times, they cause us to tear at our hair, it is not because they are not interesting—we tear our hair because we don't know the answers. Of course, we are reasonably prepared to answer questions relating to power plant equipment and operation but when we are asked to give an accurate estimate of the number of ¾ in. gimmicks of one kind or another used annually in the tooth brush industry, it isn't funny. A couple of months ago, as you already know, someone asked us, "How do you acidize a well?" Gosh! We scratched our heads. How could we know? We draw our water from a tap in the kitchen. Well, anyway, we found out, and if you read the Q&A section, you will see, in a future issue, a fine letter on acidizing wells from our good friend L. W. Fitzpatrick, Chief Engineer of the Department of Corrections at Jefferson City, Mo. We were still wondering about acidizing wells, when in comes a post card from a reader with the following notation: "Dear sir—Where can I buy a filter press for home use to filter 100 gallons of wine a year? They have these filter presses in different countries for homes—is there any in this country?" Yes, he had an Italian name. But, my gosh! we don't profess to know anything about making VINO. We did our best, however; we looked up all the manufacturers of filter presses we could find and sent him a list with suggestions as to where he might have the best luck. Then, there was a reader, some years ago, who calmly asked us to design, and draw up complete specifications for a high-voltage transmission line but in all honesty we did not come through that time—we felt we had to draw the line somewhere and this was it.

CONTENTS

Tricks in Dismantling Concrete Structures 86
By H. B. McDermid

Effects of Surface Film on Commutation 87

Basic Power Plant Figuring 89
By William H. Engelman

Efficient Combustion of Natural Gas 91
By Edward M. Bingham

Another Power Plant Laboratory 93
By Donald Rushmore

What Ailed the Engine? 94
By H. B. McDermid

Humidity Principles 95
By W. H. Martin

Practical Hints and Kinks 95
- How, and How Not, to Light Off a Boiler Furnace
- Second Hand for Files
- Need Thin Hook-up Wire? Here It Is
- Stud-Bolt Troubles
- Rugged Nickel Steel Electromagnet
- Cord Reinforcement
- What Boils Earlier, Fresh or Boiled Water?

Questions and Answers 98
- What's Right Answer to Pipe Condensation Problem?
- How Do You Space Supports for Copper and Aluminum Pipe and Tubing?
- What Is Best Heating System for a Church?
- How Should Small Plant Store and Handle High-Moisture Coal?
- He Wants to Know About Bearings

A Section of Power Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
110 S. Dearborn St., Chicago 3, Ill.

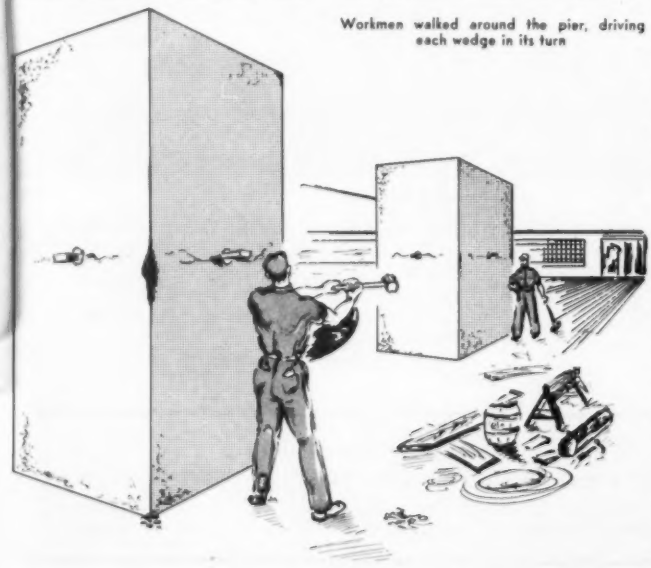
Tricks in Dismantling Concrete Structures

In this article Mr. McDermid describes a number of very interesting jobs involving the dismantling of concrete piers, compressor foundations as well as the application of these same methods in other construction operations. The practical value of these methods should be of interest to all practical engineers

By H. B. McDERMID

DURING the installation of the hydraulic turbines in a very large, but low head hydro-electric power house, the spiral cases of the turbines were cast in the monolithic concrete of the powerhouse basement. This design necessitated the placing of the cast iron speed rings, both upper and lower in their proper positions and casting the concrete around them to hold them rigidly in place. The upper speed ring was held up on top of eight temporary concrete piers, each a yard square in section and some 12 feet high, cast in place, with sufficient clearance left on top for about a foot high pile of shims and wedges. These wedges were carefully driven to exact height, and so arranged that they could be backed out and the shims removed, once the supporting concrete had been placed and hardened around the upper speed ring. As they were placed only for temporary use and were intended to be taken out as soon as their work was completed, the supporting piers were poured with no reinforcing steel placed in them: but as they were too large and heavy to handle by the existing cranes at that stage of construction, they had to be cut down to a size which would permit of easy handling.

The method of doing this was interesting. A power air drill was set up and a 3 in. hole approximately a foot deep drilled horizontally, in each of the four faces, the hole being located at the approximate center both ways of the face in which each was located. Then, heavy iron wedges were placed in each hole, with half round steel shims on top and bottom so that the hole was filled tight with the set-up, and the pinch of the wedge was exerted in a vertical line. Then a medium sized sledge was brought into action, and the wedges tightened moderately, one at a time, the workman walking around the pier and driving each wedge in its turn, never any of them to full capacity.



Workmen walked around the pier, driving each wedge in its turn

In a very short time the pier was split neatly around the line of the holes, and the two halves were ready to be hitched onto the crane and be taken out. All the 17 units in the power house had their piers removed in the same way, without fuss or bother and without any interference with other work going on nearby—a task that looked impossible at the start, especially in such an easy way.

These piers looked mighty solid before the drilling was begun, but for a period of well over a year, it was an ordinary sight to see another set being wedge cracked in two and the parts hoisted up out of the way.

Incidentally the concrete blocks remaining, were used to test weight each unit foundation as the work progressed, at test load of considerably more than each foundation would have to bear in service, being imposed on each unit and deflections carefully checked as the work progressed.

On another occasion, the concrete bursting experience gained on the job was very useful. A steel construction job had been completed except for final cleaning up, and part of the job remaining was to take out down to the grade line, some good solid concrete air compressor foundations. The compressor had been of the twin cylinder design, belt driven from a pulley mounted on the center of the shaft, so the foundation was U shaped in plan, with a section perhaps 30 in. high by 24 in. wide. The motor base was perhaps 30 in. square by 18 in. high, all of good rich concrete, plenty well aged. Just a skeleton crew was left—an assistant foreman and two old time mechanics who were pretty sure they knew more than the boss any day. The boss had looked the job over and decided this was a good place to try out the wedge technique and so, telling the men what the job was, went to the office to ask for some half round steel and wedges. When he got back to the job he found his two men had tackled the motor base with concrete points and sledge, leaving him the ten times as large compressor base to handle alone. The boss brought concrete drills and sledge and started drilling holes at the grade line of the foundation, perhaps two feet apart. The work, done by hand alone went rather slow, but by the time the steel wedges arrived, the holes were ready, drilled perhaps six inches deep. The men who thought they had all the best of the boss were mystified as he com-

menced to place his half round shims with the wedge started in between each pair in the holes. (Care should be taken to have the half round of the shims as near the same radius as that of the holes, so they get a solid "bite" at once.)

In this instance, the boss did not know the history of the pouring of that block and so could only guess as to whether there was any reinforcing in it or not; nor did he know from actual experience whether the 1½ in. holes he was compelled by his available drills to drill were large enough to give his shims enough area on which to work to sustain the necessary bursting pressure across the whole block. So he went ahead with the certain knowledge that his men expected him to fail, and without the sure knowledge that his dimensions were right for the job. The men were watching him with open amusement, as he started driving wedges, but the shims and wedges did the job as easily as they had on the big job, so that in about ten minutes he had the first block broken loose at the grade line, and also away from the main U block, had it jacked up at one end with a track jar, had the "cannon wagon" straddling it and was hooked up ready to go to the dump.

In the meantime the other two men had somewhat damaged the motor block but were badly bested and it was heartening to the boss to hear a very meek voice ask shortly, "Boss, if you're done with those wedges, can we borrow them?" Needless to say, that pair were tame from then on in.

Other examples of splitting concrete or rock by the comparatively slowly acting forces of expansion, come to mind. One that was not pleasant, happened during the setting of a small air compressor. Its foundation block was ready for use with foundation bolts in place, but inaccurately spaced when the erection crew came to the job; the only way the bolts could be made to pass through the holes in the frame of the machine, was to wedge them over in the holes in the foundation, in which they were set somewhat loosely sidewise, after a common manner of setting such bolts. But the mechanic setting the job could not get iron wedges without considerable delay, and so elected to use wooden ones in their stead—drove them in the holes tight beside the bolts and did a nice job of setting the unit otherwise, so that the foreman O.K.'d it for grouting. The concrete foundation block was perhaps six feet long by 30 in. wide and about the same height, with only four hold down bolts near the corners. The job was soon grouted in and left to harden in overnight. Next morning every bolt hole was found burst out across the corners of the block, all the way from the top to the bottom, from the expansion of the dry wood soaking up the moisture from the grout. As the job was O.K. except for looks, a hurry call for a cement finisher fixed that, and the job passed inspection all right, and likewise stood up with no sign of cracks after two years of steady service. But the experience proved the fallacy of using tightly confined dry wood in such a place if you dont want such holes to burst.

Similar results have been reported in excavating moderately solid rock. The powder supply gave out on a trench job one day and the quarry man in charge filled all the drilled holes with dry wood, driven tightly, and then set a powder can full of water, arranged so a steady drip would reach the wood until the supply was gone. Left for the night, the results in the morning were so good that they used the system thereafter until the job was done.

At another time a sewer ditch had to be excavated quite close to a large brick chimney. Mindful of the sizeable bills for chimney construction, the management refused to permit any blasting, no matter how carefully done, in a hard limestone ledge encountered. Here the dry wood in the drilled holes was used, and expanded by means of soaking, to aid in excavating a narrow ledge where all other usual methods were taboo, and did the work very successfully, avoiding all damage to nearby expensive work.

In bringing the above examples of the usefulness of wedges and their very extensive bursting power due to their shape and in the case of dry wooden wedges, the usefulness of the expansion provided by the soaking of such wood with water, no thought has been entertained of presuming that such forces can ever take the place of explosives ordinarily used for such work; but only to point out that such wedge and expansive forces do exist and can be readily used in the manner noted and in spots where higher explosives cannot be so readily used.

Effects of Surface Film on Commutation

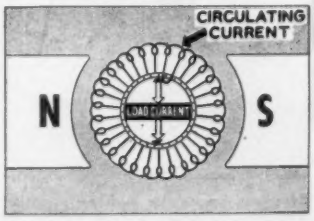
Motors in certain industries are exposed to gases and vapors which may have an adverse effect on the commutators of the machines. In discussing the subject in a recent issue of *Westinghouse Maintenance News*, C. Lynn and H. M. Elsey pointed out how trouble due to such surface films may be eliminated or at least reduced

COMMUTATION normally is considered from the standpoint of the reactance voltage produced in the machine due to load current and rotation-voltage which is short-circuited by the brush. This voltage can be considered as being produced by a changing and reversing current through the self and mutual inductance of the armature coils being commutated, or it may be thought of as being produced by the armature coils being commutated, cutting a resultant armature field, stationary in space, located in the interpolar space between each main pole and produced by load current in the armature coils themselves. In any case, the designer is interested in proportioning his machine so that the magnetic structure and the winding combinations and commutator and brush rigging give a structure which develops the desired voltage, carries the designed current, and will commutate successfully.

The current resulting from the reactance voltage is limited by the contact drop of the brushes, the resistance of the brush itself, and the resistance of the armature coils. Sparking occurs when certain magnitudes of voltage and current result at the brush. The values depend on several factors effecting the intimacy of contact between the brush and the commutator.

Mechanical Roughness

Mechanical bar-to-bar roughness of the commutator and vibration of the machine result in poor contact, which can lead to sparking. The contact drop at the brush varies with the constituents and processing of the brush itself. This is limited ordinarily to a value in the neighborhood of ½ to 1½ v. A high value is desirable from the standpoint of limiting the circulating current, but produces excessive heating on account of the load current.



Two kinds of current tend to flow in the commutator—Load Current and Circulating Current

THE PRACTICAL ENGINEER AND ELECTRICIAN

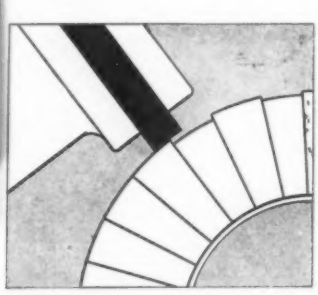
Copper from which commutator bars universally are made is affected by atmospheric conditions, with the result that a film is formed on the commutator surface. Oxide films are conducive to successful commutation, while films produced by many gases such as hydrogen sulphide, are detrimental. As little as one part of hydrogen sulphide in 35,000,000 will result in the formation of a tarnish film on copper. Water vapor is also necessary for commutation in air. A value of 1½ grains per cubic foot of air is the minimum.

Brushes sometimes pick up copper and small flakes, sometimes so minute as to be unseen by the naked eye, and up to sizes of 1/16 inch or more square — these become embedded in the face of the brush. This occurs most often when hydrogen-sulphide gases are present in the atmosphere. This copper forms copper-to-copper contacts on the commutator and results in threading of the commutator and poor commutation.

Effects of Gases

Gases from industry, such as from chemical plants, coke ovens, and so on, can contaminate the air in which d-c machines operate, to the extent of causing poor commutation and excessive wear of the commutator and brushes. In such instances, the installation of a re-circulating ventilating system with water-to-air coolers, mechanical filters for removing dirt and carbon dust, and activated charcoal filters, will provide clean and cool ventilating air for a d-c machine.

D-c machines can be operated in a hydrogen atmosphere with successful commutation and with no changes in the electrical design. However, if sparking is present, the brush wear may be higher than in air unless the relative humidity is kept below ten per cent.



Sometimes commutator bars loosen so that bars and mica present a rough surface. The resulting corduroy effect causes sparking—sometimes so severe as to produce a flash-over

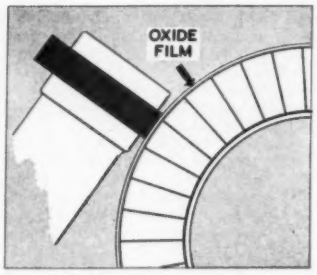
Vapors from silicone insulation on d-c machines which have totally enclosed re-circulating ventilating systems, can result in destructive sparking and rapid brush wear. The concentrations required for this are very minute—in the neighborhood of 10 to 200 ppm. Temperature of operation of the machine is an important factor, since rate of vapor elimination increases with the temperature, even after the varnishes have been cured by high-temperature bakes.

To Remove Obnoxious Films

Often, obnoxious commutator surface films are removed as they are formed, by the use of cleaning or scouring brushes. The control of these brushes is very difficult, since the formation of film on a commutator is not constant, but varies with the load on the machine and the type of brush used. The solution is simply a cut-and-try proposition, and may require the addition or removal of cleaner brushes with time and load variations.

Because commutator surface-film conditions exert a large influence on the successful commutation of d-c machines, duplicate machines may operate with an entirely different performance in the field, even though they pass the manufacturer's tests successfully. While loading conditions have a pronounced effect, this variation is often due to the surrounding atmospheres under which the machines have to operate.

At the present time, very little is



Carbon graphite and metal graphite brushes wear away and promote the formation of an oxide film on the surface of the commutator

"Got a hairpin?"

known about the intrinsic properties of the surface films produced on commutators under various operating conditions, but the detrimental effects are recognized. Much work is being done on producing brushes inherently designed or chemically treated during production to react with the films. Where satisfactory brushes cannot be obtained for a given installation, the use of scouring brushes, occasional grindings of the commutator, or the installation of a controlled ventilating system are necessary for successful continuous operation. Continued work on this problem will lead to modifications in the design of the machines or developments in the chemistry or processing of brushes which will provide satisfactory operation.

Basic Power Plant FIGURING

A Review for Old-Timers — A Must for Young-Timers

By **WILLIAM H. ENGELMAN**, Mechanical Engineer
Department of Water & Light, City of Cleveland, Ohio

All re-publication rights reserved by the author.

Steam Engine Calculations

How to Figure:—Mean Effective Pressure (mep); Indicated Horsepower (ihp); Piston Speed (fpm); Engine Constant

MANY STEAM ENGINES are in use in industry today, kept in excellent operating condition and rendering excellent service and high efficiency. They drive electric generators, stokers, fans, sometimes pumps, often air compressors, and a variety of other equipment. In cases where the exhaust steam can be used for heating or process, the over-all thermal efficiency is high. In cases where the steam consumption is a factor, the steam engine in capacities of a few hundred horsepower may beat the steam turbine in water rate.

Steam engines may be horizontal or vertical, with many types of valve gear: Corliss, slide, poppet, riding cut-off, piston, gridiron and so on. Modern uniflow engines were used in marine work during the last war and they are being installed in industrial power plants today. You never know when you will have one or more old or new steam engines under your supervision. Aside from the physical details of particular engines you will encounter, there are a number of calculations you will have to make in connection with them.

The Indicator Diagram and the IHP

Principal of these is the indicated horsepower. This is based on the diagram made by a steam engine indicator. This device and its uses are completely described in any textbook on steam engineering. A particularly good discussion of the indicator and indicator diagrams is given in Elementary Steam Power Engineering by MacNaughton (John Wiley & Sons, Inc.)

Object of obtaining an indicator diagram of the engine is to find with considerable accuracy the mean effective pressure on the engine piston, since the indicator gives a diagram of the pressures in the cylinder at each point in the stroke as the steam expands in the cylinder.

The area of the indicator diagram is measured either by a planimeter or by co-ordinate measurements. This area, in square inches, is divided by the length of the diagram in inches and multiplied by the scale of the indicator spring; and the answer is the mean effective pressure in pounds per square inch. (See MacNaughton).

Figuring IHP

In calculating the indicated horsepower of a steam engine, the following symbols are universally used:

P = mep, the mean effective pressure in pounds per square inch, psi.

L = length of stroke in feet. L in inches ÷ 12 gives L in feet.

A = area of piston in square inches = diameter squared × 0.7854.

full area at head end, H.E.; deduct area of piston rod at crank end, C.E.

N = number of working strokes per minute; a revolution is 2 strokes.

33,000 ft-lb per minute is one horsepower, the rate of doing work.

The mep obtained from the indicator diagram is the average pressure acting on one side of the piston less that acting on the opposite side.

$$IHP = \frac{P\,L\,A\,N}{33{,}000}$$; where $\frac{L\,A}{33{,}000}$ is the engine constant.

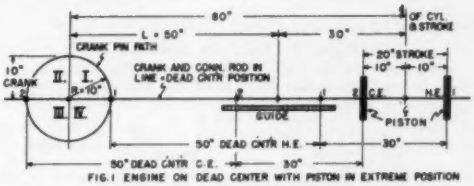


FIG. 1 ENGINE ON DEAD CENTER WITH PISTON IN EXTREME POSITION

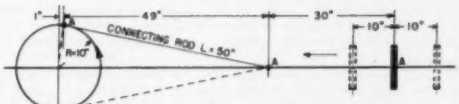


FIG. 2 CRANK POSITION WITH PISTON AT HALF-STROKE

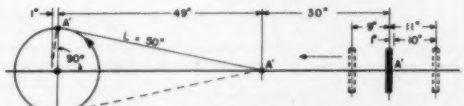


FIG. 3 CRANK POSITION AT 90° FROM HORIZONTAL LINE SHOWING PISTON HAS COMPLETED 55% OF STROKE OR 11 IN.

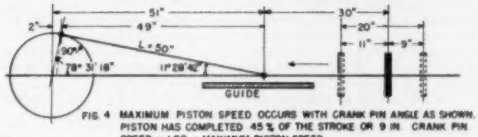


FIG. 4 MAXIMUM PISTON SPEED OCCURS WITH CRANK PIN ANGLE AS SHOWN. PISTON HAS COMPLETED 45% OF THE STROKE OR 9 IN. CRANK PIN SPEED x 1.02 = MAXIMUM PISTON SPEED

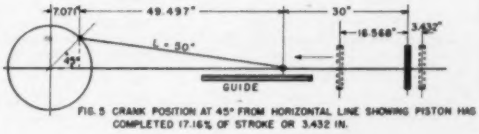


FIG. 5 CRANK POSITION AT 45° FROM HORIZONTAL LINE SHOWING PISTON HAS COMPLETED 17.16% OF STROKE OR 3.432 IN.

$$\text{Total IHP} = \frac{P_h\,L\,A_h\,N}{33{,}000} + \frac{P_c\,L\,A_c\,N}{33{,}000}$$

P_h is for head end, H.E.
P_c is for crank end, C.E. due to area of piston rod.

The head end is doing more work than the crank end for the same mep, because of the piston rod, but the difference is very small and in most cases neglected except for exact test purposes. The total

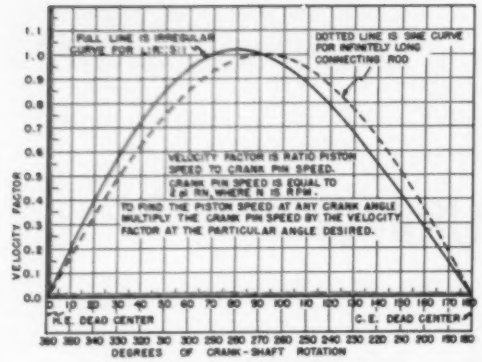

FULL LINE IS IRREGULAR CURVE FOR L.R. 5:1
DOTTED LINE IS SINE CURVE FOR INFINITELY LONG CONNECTING ROD
VELOCITY FACTOR IS RATIO PISTON SPEED TO CRANK PIN SPEED.
CRANK PIN SPEED IS EQUAL TO 2 pi RN, WHERE N IS RPM.
TO FIND THE PISTON SPEED AT ANY CRANK ANGLE MULTIPLY THE CRANK PIN SPEED BY THE VELOCITY FACTOR AT THE PARTICULAR ANGLE DESIRED.
VELOCITY FACTOR
H.E. DEAD CENTER
C.E. DEAD CENTER
DEGREES OF CRANK-SHAFT ROTATION

Fig. 6. Velocity factors for a steam engine

net pressure acting on the piston is the area of the piston in square inches multiplied by the mep., and is P × A.

The indicated horsepower, IHP., is obtained by the use of the indicator card. The brake horsepower, BHP, is the indicated horsepower minus the horsepower absorbed by friction, known as friction horsepower.

Mechanical Efficiency E = Output ÷ Input = BHP ÷ IHP.

The Engine Constant and How to Use It

In the above formula LA ÷ 33,000 is constant for a given engine and is known as the Engine Constant for that particular engine.

Example:—A certain steam engine has a 15-in. stroke and a 10-in. diameter piston. The engine constant is

$$\frac{15 \times 10 \times 10 \times 0.7854}{12 \times 33{,}000} = \frac{1.25 \times 78.54}{33{,}000} = 0.00297500$$

In this case the stroke L is known and should be included in the constant. ***But remember, this constant is only valid for a definite engine; that is, for the engine in your plant.*** In order to save time, labor and avoid errors, it is advisable to compute the engine constant for each end of the cylinder, when numerous calculations are involved.

The horsepower of an engine equals the piston speed in feet per minute times the mean effective pressure P, times the constant. In the preceding example, let mep = 60 psi, and the rpm = 200; then

The horsepower would be 60 × 200 × 2 × 0.0029750 = 71.4 IHP.

The mep and the revolutions may vary considerably, for instance, P is 58 and the rpm are 190, then

The horsepower would be 58 × 190 × 2 × 0.0029750 = 65.57 IHP.

AVERAGE PISTON SPEED in feet per minute is length of stroke in feet times the number of strokes, or twice the number of revolutions. (L N is ft per min.)

It equals:

The stroke L in feet × rpm × 2 (single acting; rpm = number of strokes) or The stroke L in feet × number of strokes per minute. (double acting)

The accompanying Table of Engine Constants suitable for any engine is based upon a piston speed of one foot per minute and a mean effective pressure P of one pound per square inch.

Example:—Using the values from the table of constants, what is the IHP of a steam engine with a 16-in. diameter piston, 24-in. stroke, running at 150 rpm, and with the mep 75 psi?

The IHP would be 0.00609279 × 2 × 150 × 2 × 75 = 274.2

To solve this problem by the regular horsepower formula

Remembering that N = 2 × rpm,

$$IHP = \frac{P\,L\,A\,N}{33{,}000} = \frac{75 \times 24 \times 16 \times 16 \times 0.7854 \times 150 \times 2}{12 \times 33{,}000}$$

= 274.2 IHP.

Without the use of constants, the formula is much more complicated as can be seen from the above examples; therefore, the table of constants should be used

Example:—

Calculate the IHP of a 10 in. by 18 in. steam engine with a 1¼ in. dia. piston rod, operating at 200 rpm. The mep at H.E. = 72.5 psi., at C.E. = 72.8 psi.

P = 72.5 psi H.E.
P = 72.8 psi C.E.
L = 18 in. or 1.5 ft.
A_h = 78.54 sq in
Rod = 1.23 sq in
A_c = 77.31 sq in
N = 200

C.E. constant = 77.31 ÷ 33,000 = 0.00234273
H.E. constant = 78.54 ÷ 33,000 = 0.00238000
0.00238000 × 72.5 × 1.5 × 200 = 51.765 IHP on H.E.
0.00234273 × 72.8 × 1.5 × 200 = 51.165 IHP on C.E.

Total = 102.930 IHP

Due to the piston rod, the constant for C.E. has to be calculated, but for H.E. use the table.

Position of Piston for Various Crank Angles from Beginning of Stroke at Head End Toward Crankshaft

Figure 1 shows engine on dead center with piston in extreme position for head end and crank ends. The circle circumscribed by the crank pin has been divided into 4 quarters, starting with No. 1 at 1, moving in counter-clockwise rotation.

In Fig. 2, the piston has moved to the center of the steam engine cylinder, while the crank pin has not yet completed the first quarter of the circle because of the limited length of the connecting rod. With an infinitely long rod, the crank pin position would have been at 90 deg from the horizontal.

In Fig. 3, the crank pin is at 90 deg from the dead center line and has completed ¼ turn, while the piston has moved more than half the stroke and is now 11 in. from head end, which means 55 per cent of the stroke.

Figure 4 shows actual crank pin position at maximum piston speed, the accompanying graph, Fig. 6, giving the velocity factor.

Table of Steam Engine Constants For Piston Diameters From 1 to 40 in., Advancing by ¼ in.

Constant = Area of Piston in Square Inches ÷ 33,000

Value in Table equals the HP of an engine with a given diameter of piston, a piston speed of 1 ft per min., and a mep of 1 psi. The constant × piston speed × mep = IHP. (Indicated HP).

Dia. of Cyl. in Inches	Even Inches	Plus 0.25" (¼")	Plus 0.50" (½")	Plus 0.75" (¾")
1	0.00002380	0.00003719	0.00005355	0.00007289
2	.00009520	.00012049	.00014875	.00017999
3	.00021420	.00025139	.00029155	.00033469
4	.00038081	.00042989	.00048195	.00053699
5	.00059500	.00065599	.00071995	.00078689
6	0.00085680	0.00092969	0.00100555	0.00108439
7	.00116620	.00125099	.00133875	.00142948
8	.00152320	.00161988	.00171955	.00182218
9	.00192780	.00203638	.00214795	.00226248
10	.00238000	.00250048	.00262394	.00275038
11	0.00287980	0.00301718	0.00314754	0.00328588
12	.00342719	.00357148	.00371874	.00386898
13	.00402219	.00417838	.00433754	.00449968
14	.00466479	.00483288	.00500394	.00517798
15	.00535499	.00553497	.00571794	.00590387
16	0.00609279	0.00628467	0.00647954	0.00667737
17	.00687818	.00708197	.00728873	.00749848
18	.00771118	.00792688	.00814553	.00836718
19	.00858178	.00881939	.00905994	.00930348
20	.00951998	.00975948	.01000193	.01024739
21	0.01049578	0.01074718	0.01100152	0.01125888
22	.01151917	.01178248	.01204872	.01231800
23	.01259017	.01286539	.01314352	.01342470
24	.01370877	.01399588	.01428591	.01457900
25	.01487497	.01517400	.01547592	.01578088
26	0.01608876	0.01639970	0.01671351	0.01703039
27	.01735016	.01767300	.01799871	.01832748
28	.01865916	.01899388	.01933151	.01967218
29	.02001576	.02036239	.02071190	.02106448
30	.02141995	.02177848	.02213990	.02250439
31	0.02287175	0.02324218	0.02361549	0.02399188
32	.02437114	.02475348	.02513869	.02552700
33	.02591814	.02631233	.02670949	.02710964
34	.02751274	.02791882	.02832788	.02873991
35	.02915493	.02957291	.02999388	.03041782
36	0.03084473	0.03127461	0.03170748	0.03214320
37	.03258212	.03302391	.03346867	.03391639
38	.03436712	.03482082	.03527747	.03573709
39	.03619972	.03666530	.03713386	.03760539
40	.03807991	.03855739	.03903786	.03952130

Efficient Combustion of Natural Gas

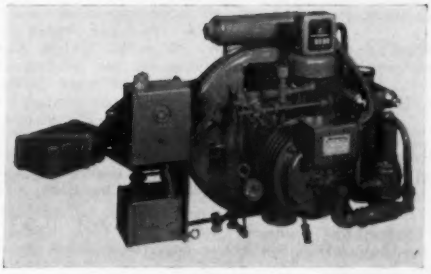


Fig. 1. Combination burner designed to burn low-pressure gas and fuel oil alternately. With this type burner changing from one fuel to the other requires less than a minute

The various Big Inch and Super Inch pipelines have brought, or will soon bring, natural gas in volume sufficient for commercial use into many areas where oil has long been the basic fuel. This article discusses the factors underlying efficient combustion of low pressure natural gas in combination burners

By **EDWARD M. BINGHAM**
Engineer,
Ray Oil Burner Company,
San Francisco, Calif.

GAS is used commercially as a fuel either because it is most adaptable to a particular process or is the lowest priced fuel. To obtain gas at the lowest price schedule, for commercial applications, it is frequently subject to shut-off during the coldest periods when domestic consumption is highest, which necessitates the use of combination gas-oil combustion equipment. Additionally, the load on gas mains in many areas necessitates a low pressure gas similar to the supply furnished the domestic consumer.

Natural gas or a mixture of city gas and natural gas comprises the low price gas fuels. These gases are composed basically of low base hydrocarbons, ethane (C_2H_6) and Methane (CH_4) which are readily and completely burned in the presence of an adequate and thoroughly mixing air supply, with objectionable flue products. The air required for combustion of such gases is roughly 10 cu ft for each cubic foot of 1000 Btu per cu ft gas, which closely approximates the air required for the combustion of the same number of Btu's in an oil fuel. Paralleling the general practice in oil firing, as much as 25 per cent excess air is used to assure complete combustion. Orsat analyses are invariably recommended to determine if the air supply is correct for the firing rate.

Gas Combustion Processes

Scientists are still in some disagreement over several of the reactions that take place during a combustion process, but we are interested only in heat release by complete combustion within the combustion space and the adjustments and tests essential to obtain this result; so it is the practical aspect that this discussion will follow:

Utilizing a gas fuel, three distinct types of combustion are observable:

(1) *Surface Combustion* takes place on the surface of glowing hot refractory. The very hot surface acts as a catalytic agent which so rapidly speeds the complete combustion that almost no flame is visible and an exceedingly high heat release per unit volume of combustion space is obtained. The requirements of this type of combustion are a 100 per cent perfect mixture of gas and air and a high temperature surface. When once started the high surface temperature is maintained by the combustion.

(2) A suspended *blue flame combustion*, called *hydroxylation*, takes place when from 100 per cent to about 50 per cent of the total air is premixed before reaching the base of the flame. If the mixture contains all of the necessary air or if all of the remainder of the necessary air is added at the base of the flame the combustion is complete and rapid and the flame clear blue. If the process is interrupted or choked by chilling below its ignition temperature before completion, CO and H_2 (both combustible) are found in the flue products. If insufficient air is introduced free H_2 and CO are also found.

(3) A suspended *"yellow flame" combustion*, termed a "carbonic" process, occurs when gas is ignited with only partial or no premixing with air. This thermal decomposition or "cracking" process, in which free carbon particles are released, is caused by subjecting the gas to heat before it is mixed with sufficient air for complete combustion. Smoking is liable to occur in carbonic combustion when there is a deficiency of air, when there is insufficient turbulence within the flame, or when the process is choked by chilling surfaces. It is for this reason that emphasis is placed upon: Orsat analyses to correctly proportion the air supply; good burner design to assure thorough mixing of the (usually low pressure) gas with the total air required; and firebox construction and installation under the supervision of engineers.

Comparison with Oil Firing

The yellow, or luminous, flame combustion of natural gas is widely employed in the industrial metal processing field but almost unknown among those primarily concerned with heating. The prevalent low pressure gas supply will, however, in burners whose capacity is of any major commercial consequence make a combination of blue flame (hydroxylation), surface combustion, and luminous flame (carbonic) combustion the general rule. Under these conditions the steps accepted in the oil burning industry to assure a clear oil fire are equally effective in obtaining cleaning and complete gas firing. These are: (1) refractory to radiate heat for speeding the process, (2) a sufficient air supply, and (3) the uniform introduction of the air through the fuel with turbulent mixing as near to the burner block as possible.

There is danger in any discussion of combustion efficiency of swamp-

ing the reader with chemical formulae and the various deductions and percentages of the components that go into making up a heat balance of "input" versus "output." But briefly, in the presence of adequate air, mixing, combustion space, and heat, the following reactions are conceded to occur:

Methane (CH_4) and ethane (C_2H_6) are decomposed into carbon, carbon monoxide and hydrogen; or, into carbon monoxide and hydrogen. These substances burn as if the reactions were:

$$C + O_2 = CO_2$$
$$2H_2 + O_2 = 2H_2O$$
$$2CO + O_2 = 2CO_2$$

The water (vapor at furnace temperatures) and the carbon dioxide are invisible, as is any unburned hydrogen or carbon monoxide; therefore, while flame appearance (clear, blue, yellow, or any combination thereof) is helpful in a partial adjustment of combustion, it is finally only by an analysis of the flue products that one determines whether the process is complete and that there is neither deficiency or excess of air. Thus in gas firing, the Orsat is an essential tool which should be kept in leak-proof condition and supplied with fresh absorbent solutions.

The gas utility companies are interested in promoting efficiency, and are usually equipped to furnish charts, similar to the one shown, for the gas supplied locally.

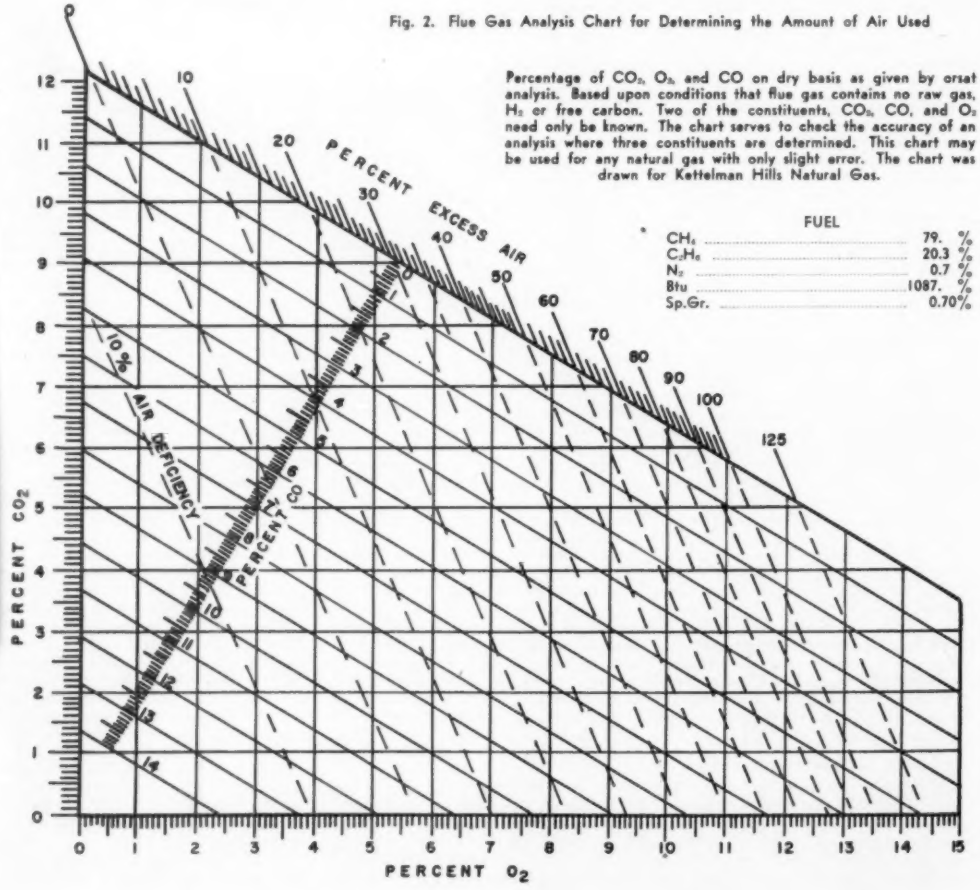
A study of the chart should serve to sum up this discussion. The highest combustion efficiency is realized by obtaining the highest CO_2, of course, in consideration of a small margin of excess air to care for fluctuations. The highest (or ultimate) CO_2 (where O_2 is zero) is in this example 12.1 per cent and it may vary as much as 1 per cent between various gases. Note that extremely high CO is the result of a deficiency of air, and also how adversely the CO_2 is affected by excess air or excess CO. Plotting the CO_2 and O_2 from an Orsat analysis the intersection should be along the zero CO diagonal. Actually, it may plot ⅛ in. either side of this line without any proof of objectionable CO. Any CO and any large amount of excess air represent avoidable losses of combustion efficiency. Unless the application requires the heating of large amounts of air as in the drying processes, the excess air should be kept within from 10 to 25 per cent with an associated CO_2 of 11 to 9.5 per cent, and this is easily obtained with good gas combustion equipment properly sized, installed, and adjusted.

See also:—Burning Gas in Modern Power Boilers; John H. D. Blanke, POWER ENGINEERING, March, 1951.

Fig. 2. Flue Gas Analysis Chart for Determining the Amount of Air Used

Percentage of CO_2, O_2, and CO on dry basis as given by orsat analysis. Based upon conditions that flue gas contains no raw gas, H_2 or free carbon. Two of the constituents, CO_2, CO, and O_2 need only be known. The chart serves to check the accuracy of an analysis where three constituents are determined. This chart may be used for any natural gas with only slight error. The chart was drawn for Kettelman Hills Natural Gas.

FUEL	
CH_4	79. %
C_2H_6	20.3 %
N_2	0.7 %
Btu	1087. %
Sp.Gr.	0.70%



Another Power Plant Laboratory

As explained in the April issue in publishing Mr. Sperry's fine description of a Power Plant Laboratory, we received other descriptions of laboratories, less complete than Mr. Sperry's, perhaps, but more suited to smaller plants which may not be able to justify such elaborate laboratories as the one described in the April issue. This article by Donald Rushmore describes such a more modest setup

By DONALD RUSHMORE

IN PLANNING a power plant laboratory for the testing of boiler water, local conditions may dictate certain special requirements, but in general the over-all picture is the same in all plants.

The inside of the boiler must be protected against calcium and magnesium scale by the addition of sodium hexametaphosphate; against oxygen pitting by feeding sodium sulphite; against rust by supplying enough sodium hydroxide to keep a high pH; against high solids, especially silicate, by continuous blowdown. The laboratory should be set up conveniently for making daily tests to insure a safe margin of these protective chemicals in the boiler water.

It is also necessary to have a section of the laboratory arranged to make up the necessary volumetric solutions, make such periodic tests, such as for dissolved oxygen, as may be necessary, and to store a supply of chemicals and equipment.

A convenient arrangement, as shown in Fig. 1, has one section of laboratory work table permanently arranged for making daily routine tests, while the second section is open. A sink divides the two parts. A table of convenient height, 30 by 60 in. for each section, will give room enough for these operations.

A shelf 30 in. above the table provides space for storing the test solutions, and also sufficient height for arranging automatic filling of burettes for titration. On the testing end, small dispensing bottles of the proper solutions are kept beside each test kit, these bottles being refilled when necessary, from the supply on the shelf. This system safeguards against running out of any solution unexpectedly.

Automatic stopcock burettes are easy to use but are expensive and rather easily broken. A very simple and inexpensive self filling burette can be made by using a one liter aspirator bottle, glass tee, glass tip, ¼ in. rubber tubing and two pinchcocks as shown in Fig. 1.

A very satisfactory arrangement for making distilled water from process steam can be made as shown in Fig. 2. A copper coil is installed in a 50 gallon barrel, the outlet extending through the side of the barrel and feeding into a carboy with a syphon arrangement for drawing the distilled water from the carboy. A continuous flow of cold water condenses the steam.

The specialists in boiler water treatment have devised simple and accurate equipment for making most of the tests. The total and dissolved solids can be measured by electrical conductivity. The phosphate test can be made with a comparator and a colorimetric disc. The same unit can be used for testing silicate and pH by changing discs. All necessary reagents are sold ready mixed by the concerns which sell the equipment.

The alkalinity and sulphite can be tested by simple titrations. The necessary solutions can be made up for a week or two at a time. Indicator solution can most easily be dispensed by using a one pint plax bottle fitted with a cork and bent glass tube. These bottles can be squeezed to force out the indicators.

With the arrangement described, after a little practice all of these

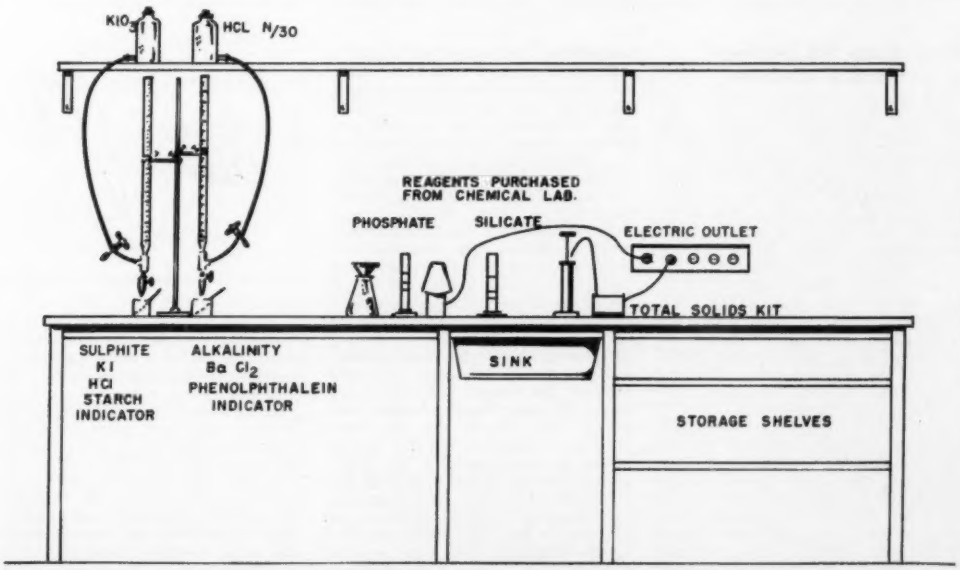


Fig. 1. Convenient arrangement of a laboratory work table

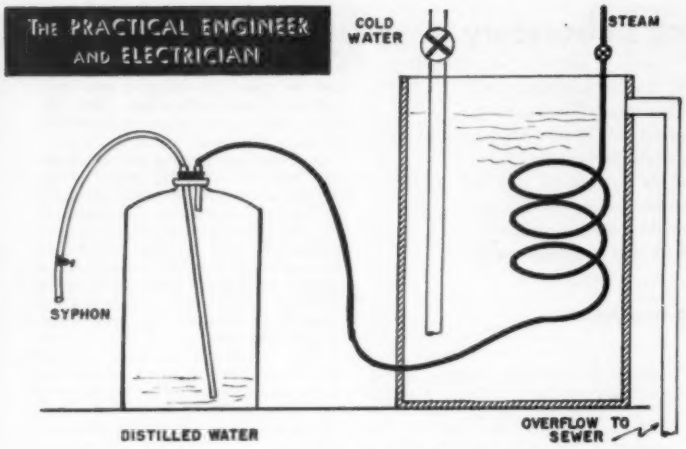


Fig. 2. A satisfactory arrangement for making distilled water from process steam

tests can be made in fifteen minutes daily.

The following list of supplies will take care of all the operations mentioned with enough to cover normal use and breakage:

GLASSWARE: (it will pay to make it all Pyrex)
- 3 1 liter volumetric flasks
- 6 250 ml Erlenmeyer flasks
- 12 250 ml beakers
- 6 600 ml beakers
- 3 100 ml graduated cylinders
- 2 10 ml graduated cylinders
- 2 10 ml graduates
- 4 25 ml graduated cylinders
- 3 40 mm x 150 m cylinders
- 4 50 ml straight burettes
- 3 1 liter aspirator bottles
- 12 stirring rods
- 3 1 pt. plax bottles
- 1 doz. 60 ml glass stoppered reagent bottles
- 6 1 liter glass stoppered reagent bottles
- 6 glass tees
- 6 glass tips
- 2 1 ml pipettes
- 2 3 ml pipettes
- 2 250 ml B.O.D. bottles
- 6 75 ml funnels
- 6 100 ml funnels
- 5 lb ¼" glass tubing
- 1 glass tube cutter

CHEMICALS: (all C.P.)
- 1 5 pt. bottle concentrated Hydrochloric acid
- 1 liter N/3 Hydrochloric acid
- 1 lb Potassium Iodide crystals
- 1 lb Potassium Iodate crystals
- 1 lb Sodium Bicarbonate powder
- 1 lb Barium Chloride crystals
- 1 lb Phenolphthalein
- 1 gallon Alcohol (denatured)
- 1 lb potato starch powder
- 1 lb Manganese Sulphate crystals
- 1 lb Sodium Hydroxide crystals
- ¼ lb Thymol crystals
- 1 complete set of spare reagents for solids, phosphates, silicate and pH kits.

MISC. EQUIPMENT:
- 3 boxes Whatman No. 5—15.0 cm filter paper
- 25 ft. ¼" rubber tubing
- 1 hotplate
- 1 chemical balance or scale of sufficient sensitivity to make up volumetric solutions
- 2 Weston Thermometers 0-220 F
- 1 doz. pinchcocks
- 2 spatulas
- 2 each of several kinds of bottle and flask brushes
- 2 lb Laboratory Calgonite or equivalent cleaner
- 1 double burette holder or ring stand and clamps
- 2 pr. 10" tongs
- 1 box corks—misc. sizes
- 1 cork borer
- 1 bunsen burner and gas supply
- 1 complete conductivity kit for testing total and dissolved solids
- 1 complete comparator kit for testing phosphates, silicates and pH. (The last two items can be obtained from Hall Laboratories, Inc.)
- 1 book—"Suggested Technical Methods of Analysis" Griffin—McGraw Hill.

WHAT AILED THE ENGINE?

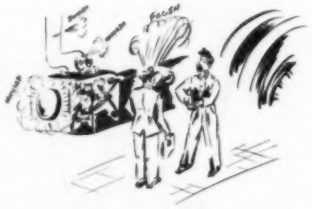
By H. B. McDERMID

AN ERECTING engineer, out "on the road" for a large company, often has need to be a quick witted diplomat, as well as a competent mechanic, thoroughly acquainted with his trade and the particular machine he is called up to place in service.

One such, recalling some of his experiences, related the following tale. During an enforced lull in the course of the installation on which he was working, due to the non-arrival of machinery shipped to the far southwest, his superintendent instructed him to go to a mine in the region, which had sent in a severe complaint regarding the behavior of an engine of the company's make.

Arriving at the mine company's office he introduced himself, naming his company to the mine manager. This man immediately launched into a diatribe on this company's products and engines in particular, and stopped only when his breath gave out. Then the engine man replied, "Mr. Blank, aren't you thoroughly ashamed of yourself? Because, if you are not, you ought to be. Just suppose you came into my office back East, a perfect stranger, as I am to you and I geared into you, just as you have into me, without giving me any chance at all, wouldn't you think I owed you an apology? I think you would. Now may I see this engine which is causing all this trouble?"

Going into the engine room, our man inspected the engine, and found all bearings hot, though loose enough to knock badly. He knew engines and machinery thoroughly, and knew his firm need make no apologies, anywhere, for the quality of their products. He was puzzled, and the superintendent evidently thought the erector was in a bad spot, till our man whirled and asked, "Mr. Blank, did you ever have any trouble with this engine before the earthquake?" Mr. Blank was completely nonplussed, and had to admit that they had not, and readily agreed to let the erector have the engine for a complete and detailed checkup. This the erector did and found about everything out of alignment that possibly could be



How did it work before the earthquake?

—frame, main bearings, shaft out of level and out of square, just about as poor an alignment as could be imagined.

He tore the engine down entirely, had the solid rock ledge on which it stood re-chipped to a good level, and carefully reset the engine the way any good erector would with a new one, and started it off—to find it ran perfectly, smoothly, and quietly, with no hot bearings, just as everyone knew it should, and to everyone's satisfaction. Commenting on the job later the erector said, "I

knew that the engine could and should run right. I knew I knew machinery and particularly our engines so well that I could readily make them do the work they were designed to do. About the earthquake—I knew we were in earthquake country, but so far as any particular 'quake was concerned and its effect on the alignment of that engine, that was just a shot in the dark—and I was glad to find that it hit the nail squarely on the head. It made that abusive superintendent pipe down, so that he all but ate out of my hand before I left."

HUMIDITY PRINCIPLES

By W. H. MARTIN

Professor of Mechanical Engineering
Oregon State College

IN THE PROCESS of adiabatic saturation of air with water vapor, the equation which expresses the relationship among the items is

$$0.24\,(t_d - t_w) + 0.45\,w_1\,(t_d - t_w) = (w_2 - w_1)\,h_{fg^2}$$

where t_d = dry bulb temperature
t_w = wet bulb temperature
w_1 = Specific humidity at dry bulb conditions
w_2 = Specific humidity at wet bulb conditions
h_{fg^2} = enthalpy of vaporization at wet bulb temperature

In this expression neither w_1 nor w_2 are known. In order to determine w_1 it is usually the procedure to first compute w_2. This can be very quickly done by using the mol fraction principle. From Dalton's law of partial pressures we know that

$$\frac{\text{Mols of water vapor}}{\text{Total mols of mixture}} = \frac{\text{Pressure of water vapor}}{\text{Total pressure}}$$

Let w = lb of water vapor per lb of air

$$\text{Mols of water vapor per lb} = \frac{1}{18}$$

$$\text{Mols of air per lb} = \frac{1}{29}$$

It follows that

$$\frac{\frac{w}{18}}{\frac{w}{18} + \frac{1}{29}} = \frac{p_v}{p} = \frac{w}{w + 0.623}$$

Where p_v = pressure of water vapor
p = total pressure of mixture

The vapor pressure corresponding to wet bulb temperature can be read from the steam table. Substitution in the mol fraction expression makes possible determination of w_2 after which w_1 can be computed by substitution in the adiabatic saturation equation above.

The mol fraction expression can again be used to compute the vapor pressure at dry bulb conditions. The mixture need not be saturated in order that the mol fraction relationship be valid. The pressure computed with w_1 known is the dew point pressure and the corresponding temperature is the dew point temperature. The ratio of this dew point pressure to saturation pressure at dry bulb temperature is the relative humidity.

For illustration purposes use the following data:

t_d = 70F
t_w = 60 F
p = 30 in. Hg
p_{v60} = 0.52 in. Hg

$$\frac{w_2}{w_2 + 0.623} = \frac{0.52}{30}$$

$$w_2 = 0.011$$

Substituting in the adiabatic saturation equation:

$$0.24\,(70 - 60) + 0.45\,w_1\,(70 - 60) = (0.011 - w_1)\,1059.9$$

$$2.4 + 4.5\,w_1 = 11.65 - 1059.9\,w_1$$

$$w_1 = 0.0087$$

To find vapor pressure at the dew point substitute the mol fraction expression

$$\frac{0.0087}{0.0087 + 0.623} = \frac{p_v}{30}$$

$$p_v = 0.413 \text{ in. Hg}$$

From the steam table the dew point temperature is 53.5 F and vapor pressure at 70 F and saturation is 0.739.

$$\text{Relative humidity} = \frac{0.413}{0.739} = 0.559$$

or 55.9 per cent

The use of this method is not limited to water vapor and air mixtures but can be used for other mixtures such as gasoline vapor and air or gasoline vapor, water vapor, and air with a fair degree of accuracy.

PRACTICAL HINTS AND KINKS

HOW, AND HOW NOT, TO LIGHT OFF A BOILER FURNACE

WHEN LIGHTING OFF a boiler don't use an improper torch, or one that may fail to remain lighted. Failure to make certain that a torch is still burning at the time the burner oil valve is opened may result in an accumulation of oil and inflammable gases in the furnace. As a result, you may try to light off again when you see that you have failed on your first attempt. THIS IS THE PERFECT SET-UP FOR A FLAREBACK that may damage the brickwork and boiler casing. There also is a good chance that your arms and face will rapidly take on the appearance of a well done hot dog—minus fur!

Needless to say, this situation is a good waker-upper for those who would mentally doze.

Now then, let's assume the torch is O.K.—you can still achieve a super sunburn if you don't handle it right. F'rinstance;

1. Lighting-off ports for saturated side furnaces or single furnace boilers have a single door. If you carry excessive air pressure and grip the burning torch very short, the blow torch effect when the door is opened and the torch started

A perfect set-up for a flareback

Ventilate the furnace

in, will most certainly shoot the flame back around the ol' wrists.

2. Superheater side lighting-off ports have independent double doors (or air-lock effect) and are normally lighted off with an excessive furnace pressure. In this case, correct operation of the double doors prevents the blow-torch effect. However, leaving the outer door open while the inner door is opened to insert the torch gives the blow-back. Neat, eh? An inexperienced or careless man can severely burn an exposed arm or wrist.

Ventilate your furnace because unburned oil and inflammable gases may exist in the furnace through previous carelessness. Failure to ventilate or purge furnaces prior to lighting off opens the way to anything from a minor flareback to a damaging furnace explosion.

ONE FOR THE MENTAL NOTEBOOK: Ventilating is accomplished merely by having the forced draft blower running and opening registers prior to lighting-off.

This *doesn't* remove oil, but it does blow out the inflammable gases which cause the real damage.

THE PRACTICAL ENGINEER AND ELECTRICIAN

SECOND HANDLE FOR FILES

By F. E. RILEY

MAINTENANCE WORK often requires a lot of heavy work with a file and anything that will help to ease the work is welcome to the file-pusher.

A new file with plenty of "bite" in it will soon begin to "bite" the fingers of the left hand and a second handle fitted to the file end where it is gripped by the fingers of the left hand will make things much more comfortable.

A simple handle can be made from a short length of thin rubber tube forced over the end of the file as shown in the photograph. The tube should be thin and fit over the file end tightly.

Such a handle fitted to square and round files when opening out holes, and such things as key seats in pulleys and gears prevents the fingers of the left hand from being nipped between the file and the hole. This often happens, particularly when the left hand is hidden behind the job and the file is pulled back too far. A rubber tube fitted over the file end will stop the file from being pulled too far back and will protect the fingers that have to grip the file.

It is a good plan to collect any odd bits of rubber tube of any diameter, and store them with a view to their future use as file handles.

Finger hold for file made from rubber tubing

NEED THIN HOOK-UP WIRE? HERE IT IS

POWER ENGINEERS usually, do not need small wire in the ordinary course of their operations but with the increasing use of electronic control equipment there may be times when small size hook-up wire comes in handy. Such wire has, of course, been available for many years, ever since the radio industry came into being. Now, however, to meet the needs of increasing miniaturization in many divisions of the control and instrument field, a manufacturer has brought out a new type of insulated wire so small that 350 wires pass through half a paper clip. Each wire consists of four strands of No. 40 copper wire so that 1400 strands occupy an area of ¼ x ⅝ in.

This new degree of miniaturization was made possible by what the manufacturer calls tensulation. The distinctive feature of this process is its use of thermo plastic, thermo elastic and other film materials in tape form — applied parallel to the conductor after this film has been heated to the precise temperature required for complete lamination coalescence. It is then instantly wrapped and draw in layers until the desired wall thickness is obtained. Additional heat and pressure, applied from all directions, assures a perfect product. The conductors, cabled or singly, may then be covered with metal or fabric braid, and other coatings for special applications. Although no dies are used, insulating wall is uniform, free from pinholes, lightweight and small in size.

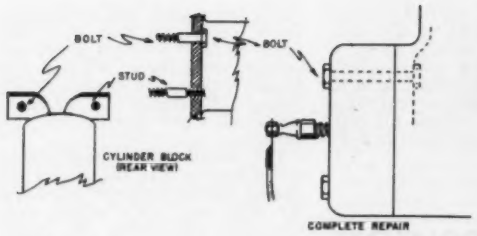
Production of tensulated conductors is devoted principally to the lighter and more flexible stranded conductors composed of tinsel or finer gauge wires for instrument cordage, hook-up wire, resistance wire and flexible cables. Tensulated insulators withstand tropic, arctic, submarine, and airborne conditions. Various colors are available in tensulated coverings and additional coding may be obtained by use of plastic inlays, colored thread tracers and other means.

350 insulated wires through paper clip

STUD-BOLT TROUBLES

By W. E. KENNEDY

CYLINDER-HEAD stud-bolts in small gasoline engines often are weakened by rusting to the point where they twist off, or shear, in attempting to remove them for cylinder-head gasket replacement, or in trying to tighten up on an old, or leaky, gasket. Such stud-bolt stubs usually have to be drilled out due to shortness and consequent lack of material for a small pipe wrench to bite into.



Sketches showing method of replacing broken-off stud-bolts

The threads in the cylinder block are usually ruined in drilling out the stud, or in chiseling out any remains after drilling a smaller-than-the-stud hole. Attempts to re-thread (in case one has the proper die pin) usually result in an oversize hole, making it necessary to use a stud larger than the original. The holes in the cylinder head may not be large enough to accommodate a larger stud; and in such cases, it may prove practical to drill out to the size hole desired where the stud-bolt stub is located and insert a regular bolt, in the manner indicated in the accompanying sketches. The bolt head rests against the cylinder-block casting and cannot turn when the nut is tightened to tighten the cylinder head on the gasket. (The stud may be drilled out with a brace drill or ratchet drill without moving the cylinder block; and this method of repair eliminates the necessity of turning down a stud bolt larger than the original to fit holes in the cylinder head.)

This method of replacing a broken-off stud bolt requires only simple tools, found in most any shop.

RUGGED NICKEL STEEL ELECTROMAGNET

By PAUL C. ZIEMKE

AN ELECTROMAGNET used in a scrap yard is a veritable whipping boy of industry since no punishment is too brutal for it to endure. Not only does it get a terrific slamming around as the operator literally throws it on a pile to crush its loosely compacted mass into a sizable mouthful for the return trip to the gondola, but it must further serve as a skull crusher to compact the car load in these days of car shortages. Otherwise the car leaves about 2/3 loaded in the matter of tons.

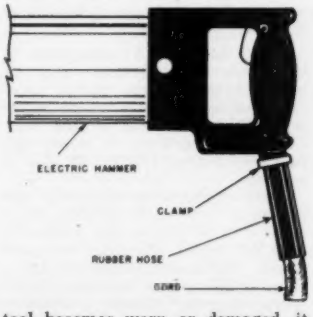
The 36 in. unit used on our job was constructed of 3½ per cent nickel cast steel. The casting conforms to type 2315 in composition and is used for the outer pole rings and the inner pole shoes. It was found highly desirable to employ a "magnetically soft" material (as compared to the magnetically hard or permanent magnet, types of alloy) for maximum efficiency. The low carbon nickel steel meets our requirements most admirably, and in addition possesses the necessary toughness and wear resistance for our rugged service.

Magnet cleaning up the remains of a giant pile of rigid and thinwall electrical conduit

Pictured is the magnet cleaning up the remains of a giant pile of rigid and thinwall electrical conduit cut into handling lengths by the shears. Such material lies in a heterogenous manner not unlike the proverbial jack straws and unless the magnet flattens out the loosely organized material the load is far from profitable. Type 1 Ni-Resist (15 per cent nickel, 6 per cent copper, 2 per cent chromium iron) makes the outer housings and rings wear resistant and is non-magnetic.

CORD REINFORCEMENT

IF THE WIRE or rubber protector employed on portable electric tools to prevent sharp bending of the electric cord where it enters the



tool becomes worn or damaged, it may be possible, as shown, to use a suitable length of rubber hose of proper diameter and wall thickness.

WHICH BOILS EARLIER, FRESH OR BOILED WATER?

By WILLIAM ORDINANZ

BOILED WATER, you will surely answer, if this question is asked you. And you will not be alone in believing this. Most everyone thinks that boiled water will boil sooner, for no particular reason, perhaps, but it just seems obvious. Actually, the answer is just the opposite. Boiled water is, of course, softer, having lost a good part of its hardness during the boiling. Nevertheless, fresh water boils earlier because it contains more air.

Avoiding complicated theoretical explanations, it is only necessary to remember what boiling means. Boiling is nothing else than the beginning of the liquid-to-steam transformation. It begins with the first bubbles that form. Steam bubbles have a tendency to free themselves from the liquid the very moment they form. This tendency is counteracted, however, by the considerable cohesion of the liquid, this tends to restrain the bubbles from tearing themselves away. For a little white these two forces—cohesion and evaporation — counterbalance each other and little happens. It needed a help in releasing evaporation.

This is where the air comes in. Air is always present in water, but it does not affect the inner coherence of the water molecules. When heated, the air begins to escape in large bubbles and these carry the smaller steam bubbles away with

them. Thus, the boiling water evaporates.

Fresh water contains about 2 per cent of dissolved air and boils at 212 F. Boiled water, on the other hand, having lost most of its air in the previous boiling, suffers a boiling delay. It boils according to its air content, at higher temperatures than fresh water. Indeed, the boiling point can reach almost twice normal.

Questions and Answers

Question No. 486

WHAT'S RIGHT ANSWER TO PIPE CONDENSATION PROBLEM?

SEVERAL MONTHS ago (October 1950 issue) V.L.G. asked for the rate of condensation per square foot of a 1-in. pipe coil carrying 135-psig steam and submerged in 60-F water. Several individuals answering, of whom I was one, gave answers of 0.12 lb per hr, 0.9335 lb per hr, 126.7 lb per hr and 171.6 lb per hr.

After reading these answers, V.L.G. must have been more confused than before he asked the question — and so am I. Can you clarify the situation and tell us all what the answer really is? I'll bet a year's subscription to your good magazine that it won't be any of the above.

J.C.P.

Editor's Note:—We won't bet. We figured it by the method shown in ***Basic Power Plant Figuring***, February 1951 issue, Example 3, and got a still different answer. Then we tried it again using the rational heat transfer formulas and again were astounded at the figures that came out. So will our good Q & A heat transfer experts kindly set us straight on this whole matter?

Question No. 487

HOW DO YOU SPACE SUPPORTS FOR COPPER AND ALUMINUM PIPE AND TUBING?

IN THE December 1950 issue of POWER ENGINEERING, page 85, appears an article entitled, How to Space Your Pipe Supports Correctly. This includes a very interesting and valuable chart showing the correct distance between supports for various sizes of standard pipe filled with water.

We would like to know if you have available a factor we could use with this chart for copper and aluminum pipe and tubing.

Elkhart, Ind. E. J. M.

Editor's Note:—At this moment, no factors of this kind are available for copper and aluminum pipe and tubing for use with this particular chart.

However, some information has been published on the subject that may be helpful. An article entitled How to Space Pipe Supports, by Theodore E. Bridge, in ***Heating, Piping & Air Conditioning***, October 1949, shows an alignment chart for calculation of the various factors, together with a table of weights of pipe in pounds per foot, for bare empty pipe, water in pipe, and pipe with magnesia covering. It also shows a table of factors with which to correct the values obtained from the alignment chart for use with materials other than steel. This table gives correction factors for aluminum, brass, copper, chemical lead, cast iron, steel, stainless steel, monel metal and nickel.

Answer No. 477

WHAT IS BEST HEATING SYSTEM FOR A CHURCH?

THIS QUESTION, in the January issue, brought forth a wide variety of comment on the various systems that can be used. This comment brought out the various factors of space, arrangement, details of building construction, weather conditions, use factor, fuel, first costs and operating costs that must be taken into account. The comment also showed how helpful the engineering approach of an engineer member of a church congregation could be to his fellow non-technical members in making a decision on a matter of highest importance to the church.

Hot-water heating systems, steam heating systems and warm-air systems and their respective advantages and disadvantages for church heating were discussed in detail by various Q & A readers in the February, March and April issues. Use of radiant heating was also brought into the discussion.

Below is another discussion by an engineer who has had personal experience with two church heating systems.

Andrews Reports Practical Experience With Two Systems

I AM A MEMBER of a congregation in the greater St. Louis area which has installed two different types of heating systems in two different buildings within a period of one year. Practical experience in doing this may be of some interest to Q & A readers.

Our congregation formerly occupied a very small wooden frame church with permanent pews for only 60 people. Because we have nearly 300 communicant members, this building was entirely inadequate, for the normal attendance ranged from 90 to as high as 120. Originally we heated the basement with a small coal stove and the upstairs with a coal fired furnace, which had a single hot-air duct directly through the floor above this furnace and at the back of the last pew. A lovely cherry red glow was usually visible from upstairs during services. Needless to say we could not install a pew directly over this radiator.

The basement floor was always uncomfortably cold, the rear of the church upstairs was overheated and the altar and organ section were very cold and drafty. We finally threw away the small coal stove and replaced it with an oil-fired heater having a fan at the bottom, which we hoped would warm the cold concrete floor. This installation was cleaner, but generally unsatisfactory and a disappointment.

In January 1950 we spent $1,000 to install an adequate natural-gas-fired furnace with forced-draft ducts upstairs and downstairs. This was a great improvement, principally because it was very clean and neat, and we gained some space for the Sunday school by being able to eliminate the separate dirty room which contained the old coal fired furnace and the bins for kindling wood and coal. The heat on one's face in the basement was attained very rapidly and thereafter it was too hot, while the floor remained, as usual, too cold. Upstairs, things were better because the cold air ducts could be placed in the floor near the front row of pews, and because the seating capacity could be increased slightly when we took out the floor hot-air register.

On September 11, 1950, we began to build a new church of concrete and brick construction. This building is 40 feet by 80 feet and 56 feet across the back where the altar is located and there are rooms on both sides in this building. We contracted for the installation of two gas fired hot water furnaces for $5,000, with automatic thermostat controls. One of these furnaces heats the basement floor through radiant coils imbedded in the concrete; the other heats the main part of the church upstairs with panel radiators along the walls. We occupied the basement of this building in early February 1951 and consider the heating in this basement excellent. We have been very comfortable at a low cost for fuel during one of the coldest winters on record for this area. In St. Louis, on a degree day basis, the past winter averaged approximately 30 per cent below normal.

Just how comfortable we will be in the main part of the church next winter remains to be seen. We did not install radiant heating coils in the floor because we did not wish to increase its weight by the use of concrete or increase its cost by having to cover this with asphalt tile. A first-class wood floor was the preference of most of the congregation's members.

A nearby church had been equipped with this type of heating two or three years previously and this was found to be very successful. In our case the long-standing difficulty with the cold concrete floor of our former church was eliminated.

An important question is the water treating problem. Since it is unnecessary to heat the water above 85 or 90 F there is no scaling problem even though our water supply at Wood River, Ill., is characteristically very hard i.e., 400-500 ppm $CaCO_3$ hardness. Perhaps some of our friends may be able to profit by this experience although copper coils are temporarily unattainable.

Roxana, Ill. G. N. ANDREWS

Answer No. 479
HOW SHOULD SMALL PLANT STORE AND HANDLE HIGH-MOISTURE COAL?

THEY HAVE maintained an open stock pile of coal screenings for several years, said H.E.F., February issue, and have had considerable trouble in feeding and burning it as pulverized coal because of its high moisture content. How can it be stocked economically? They want to stock-pile about 600 tons for each of two plants. This is almost two months' supply. Also they want advice on how to handle and burn the coal properly, for in such small plants it is not economical to install an extensive coal conditioning system.

We referred them to several good recent magazine articles and other references on the subject. Now here is some comment from one who is in a good position to comment—a representative of the Fairmont Coal Bureau. This Bureau has given much attention to the economical handling of coal in smaller plants and maintains a free advisory service for coal consumers on problems relating to design and operation of coal-fired plants.

Control Surface Moisture Absorption, Says Given

IN THE HANDLING and burning of high-moisture coal in two small pulverized-coal-fired plants, each burning approximately 300 tons of coal per month, drying the coal at the plant cannot be considered because of the high cost involved, so the obvious answer is to control the surface moisture absorption.

Fine coal screenings collect surface moisture in troublesome quantities when proper steps are not taken to protect the coal from exposure to moisture. This is not generally true of the larger coal sizes, because of the smaller surface area of the larger sizes. Some coal producers, who are concerned about the high surface moisture collected with the fine sizes of coal in the mining operations, are crushing larger coal sizes into the slack as a means of controlling the moisture, as loaded. If the coal used in these plants is not purchased from a reputable coal operator who makes a concerted effort to control the moisture as loaded, the plant personnel will find it difficult to obtain satisfactory results through the protective measures described below.

The coal can and should be stored in reasonable quantities under a protective covering. A pile of screenings either in a coal car or in a storage pile at the plant will absorb moisture only to a depth of a few inches below the surface of the pile. Thus, there is adequate protection at these locations under normal circumstances.

However, when the coal is withdrawn from the pile on a continuous basis and in small increments, as at the plants in question, the wet coal at the surface of the pile is withdrawn and the comparatively dry coal underneath becomes exposed to the elements. If adequate enclosed storage were provided to minimize the required disturbance of the outside coal pile, moisture absorption would be substantially reduced. For plants of this size, the enclosed storage should be made adequate, to eliminate any necessity for drawing coal from ground storage except in an emergency.

For the enclosed storage, a concrete-stave silo or vertical steel bunker is recommended. Storage capacity should approximate a one-week supply of coal with a minimum of about 125 tons capacity to permit unloading the coal cars directly to the silo or bunker. The cost of a silo and bucket elevator for one of these plants would approximate $5,000 installed.

This equipment has the further advantage of being easily adapted to push-button methods of handling coal from the unloading point to the pulverizers, by the addition of simple conveyors from the unloading point to the bottom of the bucket elevator, and from the top of the bucket elevator or from a shelf in the top of the silo to the pulverizers. The latter conveyor could consist of simple down spouts, if space conditions permitted a minimum inclination of about 60 deg from the horizontal. These additional conveyors would cost anywhere from $1,000 to $4,000 depending on the equipment required.

With the complete coal-handling installation described, labor requirements for the plant could be limited to one fireman per shift plus part-time labor for unloading the coal cars, to the extent of between 2 and 4 man-hours per car. Ashes could certainly be handled by the fireman on duty in a plant of this size. Assuming that a second man is now employed in these plants on each shift for handling coal, the total investment in handling equipment could be paid off in one year or less from the resulting savings in labor costs.

The problem of using the wet coal now in storage at these plants could be minimized by gradually mixing it in with the dry coal received in future deliveries for immediate storage under cover. Mixing with a double-screened size of coal would also reduce the average moisture by a considerable amount.

New York City DONALD M. GIVEN
Fuel Engineer
Fairmont Coal Bureau

Answer No. 480
HE WANTS TO KNOW ABOUT BEARINGS

IN THE March issue, A. C. asked the following questions about bearings:

1. What is the proper way to take lead readings on sleeve bearings on pumps or blowers?
2. Are the lead-base and tin-base babbitt metals best to use if you can get them? What others are good? How many different kinds are there?
3. Is it customary to pour a bearing around a mandrel smaller than the shaft, then bore to nearly shaft diameter and scrape in?
4. How should babbitted bearings be grooved? Why do they need grooves?

Comments by Freyberg

1.—A LEAD is best taken by removing the upper half of the bearing and laying a number of strips of dead soft lead wire across the journal at right angles to the journal's axis. It is impractical to take leads on small bearings, where the bearing and journal are best fitted by "feel"; but on medium-sized bearings two or three leads will do, while on long bearings four or five are needed. Replace the cover, making sure there is no dirt between the bearing half flanges, and take up hard but evenly on the bearing cap screws, marking the position of the nuts.

Remove the cover and examine the leads. If they have been evenly flattened, the clearances are fairly uniform. Remove the leads one by one, marking the position and end relationship of each, and carefully micrometer each a number of times along its length. The clearance pattern for the journal in its bearing can be plotted easily from these readings, and shims inserted or scraping done to fit the bearing to the journal.

I would not use the one lead on the journal and two under the bearing flanges as A. C. suggests. The latter two only confuse the bearing fitter, and the former does not alone give the true picture of the fit.

If the clearances are too small, shims must be inserted. If they are too large, shims must be removed

or the bearing re-poured. If the leads are unevenly flattened, it will be necessary to scrape in the bearing.

2. Bearing metals may vary somewhat with the service, and I guess theoretically there is an infinite number of different "babbitts" depending on the percentages of tin, antimony, copper, etc., used. Bearing metals must be soft enough to prevent scratching and seizing the journal, yet hard and strong enough to carry the load without wiping or pounding out. A smaller bearing area is required for a "hard" bearing metal than for a soft one. You might list the bearing metal "suitability factors" as: 1) low frictional properties; 2) mechanical properties such as tensile strength, compressive strength, ductility and hardness; 3) non-seizing properties; 4) castability, and 5) availability.

Most bearing metals have two "phases"—a soft matrix in which the hard particles, which take the wear, are embedded. The true babbitts are the tin-base bearings which range from hard (82 per cent tin, 10 per cent copper, 8 per cent antimony) to soft (90 per cent tin, 5 per cent copper, 5 per cent antimony), but there is no reason to assure A. C. that any of them is the "best to use for bearings." These are probably the easiest to pour, and have generally greater compressive strength with higher permissible running temperatures. They are, however, the most expensive, and are subject to fatigue failure.

Maybe some of the substitutes developed from the lead-based bearings, such as the Satco type of 2.4 per cent tin, 0.15 per cent copper and the balance lead, would give him good service. They will take pounding, local overheating and have good compressive strength. Most of the substitutes were developed for special applications and it wouldn't do to try to list them all for A. C. There are copper base bearings, bronze with lead (such as Ajax), copper with lead (such as Allan Metal), bronze with graphite (Oilite), cadmium silver, silver, cadmium nickel, etc. Most of them require very special techniques for putting them into steel backings.

3. A. C. is right that it is customary to pour babbitted bearings around a mandrel smaller than the shaft but his procedure from there varies from what he should do. The bearing should be rough-bored to within about 0.060 in. of journal diameter and then smooth-bored to a diameter the exact size of the journal plus the amount desired for oil clearance. Many bearing men like to scrape in the whole oil clearance or at least part of it.

4. When he asks "how should the bearings be grooved," he is asking for a couple of pages of information, since grooving varies with the application.

A bearing grooved for a turbine shaft will not properly distribute the oil or carry the load for, say, a reciprocating engine or a gear train. Oil grooves are used to distribute the oil and are normally on the points of the circumference where the pressure is slight. Bearings are beveled at the entrance and exit for the oil, usually at the joint of the bearing halves, for an arc of about 20 deg except for a portion at the ends which should be left to prevent loss of the oil. The beveling, the oil clearance, the grooves, and the pumping action of the journal combine to adequately lubricate the bearing and carry away the heat generated in the bearing.

Care must be taken that a minimum of grooving is done, to prevent loss of bearing area and breaking down of the oil film. Grooves should generally be shallow and with rounded rather than sharp edges, and no grooves should extend the full length of the bearings, again to prevent the loss of oil.

Pleasantville, N. Y. R. H. FREYBERG

Comments by Brage

WEAR OF ANY JOURNAL bearing is caused by two forces. One of these is gravity. Wear due to this force is proportional to the weight of the shaft and attachments, such as flywheel and rotor, and inversely proportional to the amount of bearing surface.

In most motors, the second most common cause of journal bearing wear is the sidewise thrust of the shaft under belt or chain tension, or due to reaction (back pressure) of air, water, or other fluid against fan or impeller vanes.

The actual wear of a bearing is the resultant of these two forces, and produces wear in an elliptical shape in cross section downward and toward the driven pulley in indirect drive, or away from the fluid outlet of direct drive, as in fans and blowers and pumps.

Such wear is accentuated by the presence of grit, absence of lubricant, roughness of the shaft, lubricant of the wrong quality, temperature increase and characteristics of the bearing metal.

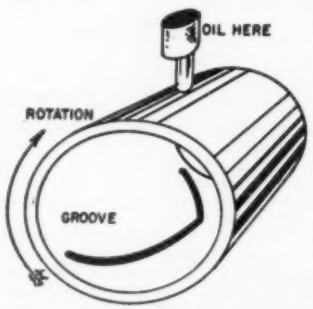


Fig. 1. Sketch by Brage to show sleeve bearing grooves

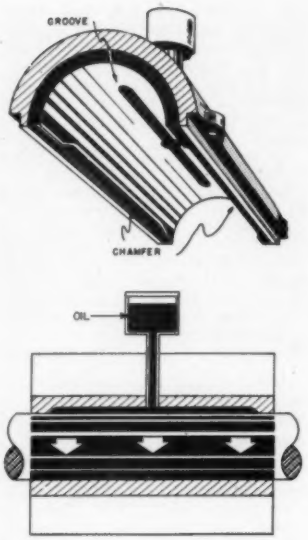


Fig. 2. On heavy-duty split bearings a top groove is recommended if bearing is long or uses a heavy oil

Here are some comments on A. C.'s specific questions.

1. Lead wire readings should not be depended upon, unless it is known that the shaft is level and in perfect alignment, and that the bearing cap sets snugly on the shaft.

2. The original babbitt metal was tin-base, with hardness and tensile strength increased by the addition of almost equal proportions of antimony and copper. Typical analysis: Tin—0.833; antimony—0.0833; copper—0.0833. Other tin-base babbitts contain more tin and less antimony and copper.

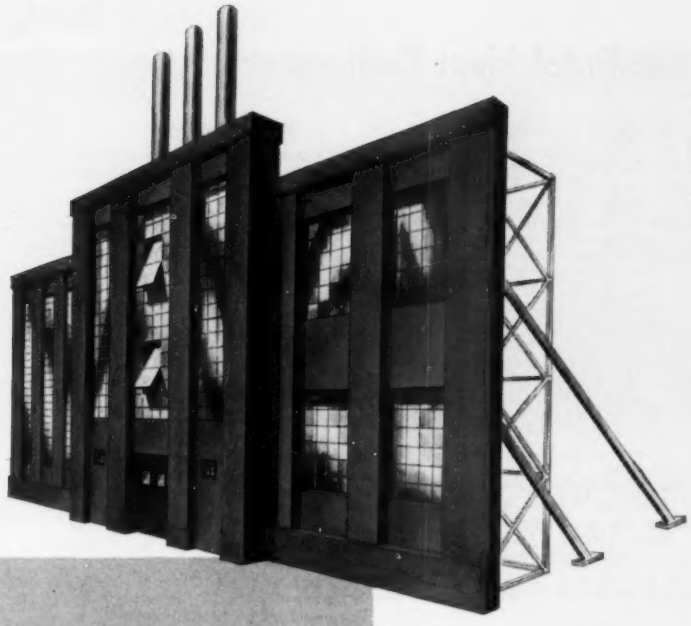
Tin-base babbitts contain little more than 8 per cent antimony, and the same amount of copper. Lead-base babbitts, however, contain 10 per cent or more of this strengthening and hardening element. Typical lead-base babbitt analyses: lead—0.85; antimony—0.15.

In general, lead-base babbitts contain no copper, and the percentage of antimony is increased to compensate for lead being softer than tin.

Aside from the purely lead-base and purely tin-base babbitts, there are the mixed-base babbitts containing a very small proportion of copper, and much smaller proportion of tin to lead. A typical lead-tin babbitt contains: lead—0.635 to 0.90; tin—0.05 to 0.20; antimony 0.10 to 0.15; copper 0.005 to 0.015.

In brief, a babbitt consists of two or more of the following: tin, lead,

(Continued on page 120)



There's more than meets the eye...

This is The BETZ INDICATOR, a monthly publication devoted to general discussion of all water problems. It's free. Write.

. . . especially in a boiler plant!

Insofar as mechanical equipment is concerned, a boiler plant may be complete in every respect. But, completeness of equipment will not necessarily assure the most efficient operation of the system. An adequate and well-controlled program of boiler water treatment, too, is highly important. A water conditioning engineering service should be an integral part of your plant operation.

As a nationwide service organization of engineers and chemists specializing in the solution of all water problems, we offer a complete water conditioning service that is scientifically correct . . . complete . . . economical. If the results you are presently obtaining are not entirely satisfactory, let a BETZ engineer explain more fully how our specialized service can help you. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

Leak-Proof Heat Exchanger

SPECTER of a possible tube failure with its dire consequences is always in the mind of the heat-exchanger designer. So many factors contribute to tube failures, such as poor water supply, excessive vibration, incorrect installation, improper venting, tube flaws which pass initial inspection but open up after being in operation a short time, and other items over which the designer very often does not have control, that it is practically impossible to eliminate the tube failures themselves. If the magnitude of the consequences can be reduced, it contributes to the peace of mind of designer, operator, owner and others concerned. A means of doing this is shown here.

That means is a heat exchanger to be described below. It is used for cooling the air stream recirculated in electric motors and generators and is commonly known as a double-tube surface air cooler. The heat is carried away by the cooling water. This heat exchanger can be used with other fluids and on other applications. It was described in detail by J. T. Cullen, Design Engineer, Steam Turbine Engineering Division, General Electric Co., in a paper before the Annual ASME meeting, New York, November 1950.

General Description

A completed actual double-tube air cooler consists of a double set of tubes and a double set of tube sheets, Fig. 1. Cooling water flows through the inner tubes while the air is passing over the finned outer tubes. In case of a leaky inner tube, the grooves in the outer tube provide passage for the water to a leakage space between adjacent tube sheets and then to a leakage drain where it can be readily detected. The raised portions of the inner surface of the outer tube provide the metal contact with the inner tube for transferring the heat from the outer tube to the inner tube.

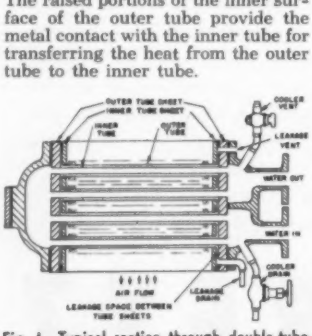


Fig. 1. Typical section through double-tube air cooler. Leak in water-carrying inner tube goes to space between inner and outer tubes and then to the leakage space and harmlessly out leakage drain

Unusual Features

The inner tube is a standard ⅝ in. O.D., 0.049 in. wall seamless tubing 70-30 copper-nickel ASTM specification B-111, except for tolerances discussed in the paper. Other materials used have been admiralty and aluminum brass. Tools for installing and cleaning are readily available for this size tube.

The outer tube is ¾ in. O.D. in order to be able to use tools which are already developed for winding the external fin required for this particular application. The inside diameter is equal to the outer diameter of the inner tubes. The inside surface is fluted in order to provide the leakage run off and the metal contact with the inner tube. Outline of the tube assembly and each of the tubes is shown in Fig. 2.

Metal contact to provide a heat flow path between the inner and outer tube is obtained by expanding the inner tube radially out against the inner surface of the outer tube. The paper gives details of the tolerances and size of expander to do this to best advantage.

The early models specified that inner tubes could be replaced but field experience has shown that the leaky fluid, especially salt water, corrodes the metals together, and it is more feasible to plug the leaky tubes and continue to operate until the number of faulty tubes is such as to impair the efficiency of the unit, at which time it should be replaced by a new one.

Tube flaws which do not show up at surface inspection very often make themselves known when the inner tube is expanded. An example is slag inclusion in the tube, which is covered over lightly with metal and appears perfect and passes the tube mill's test, but opens up when the tube is expanded. To avoid such occurrences, a tube flaw detector is used to examine each tube previous to installation. This tube flaw detector is an electronic device developed by the General Engineering and Consulting Laboratory of the author's company specifically for testing tubes. In this detector, the tube is pushed through a detector head containing two electrical coils. A flaw passing through one of the coils unbalances the electronic circuit and sounds an alarm.

Performance

The evaluation of the effect of the joint on heat transfer was made by comparing the performances of single tube coolers, ¾ in. O.D. tubes, 0.049 in. wall and nine fins per inch, with those of a double tube cooler. This calculation is given in the paper.

Experience

Over 2000 coolers of the double tube type have been made to date in a period of over 14 years. Practically all the present installations are aboard ship. There have been tube leaks the same as there would be if the cooler were made of single tubes, but there has been no case, of which we have knowledge, where a leak in the inner tube has produced a leak in the outer tube. The failures and other difficulties on the double-tube cooler occur no oftener than for the single tube type. Performance has not been affected appreciably because of any possible deterioration of the joint with age. The present range of experience covers water in the inner tube at temperatures up to 95 F. and air on the gas side up to 185 F.

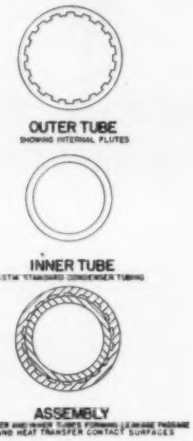


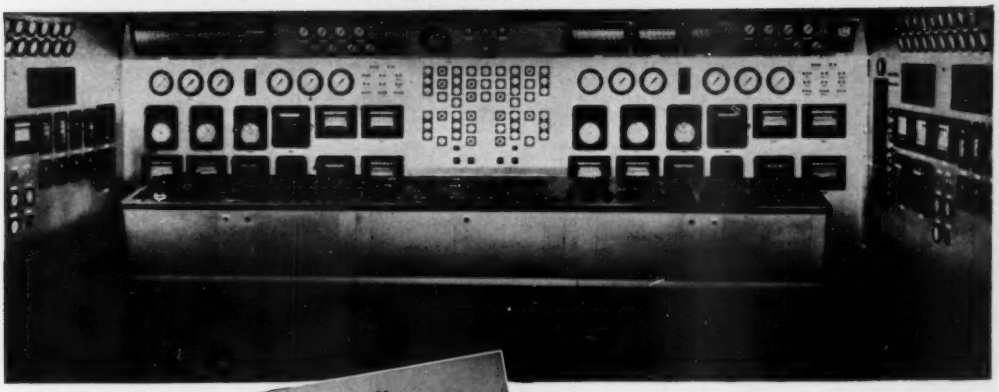
Fig. 2. Sections of tubes of double-tube cooler

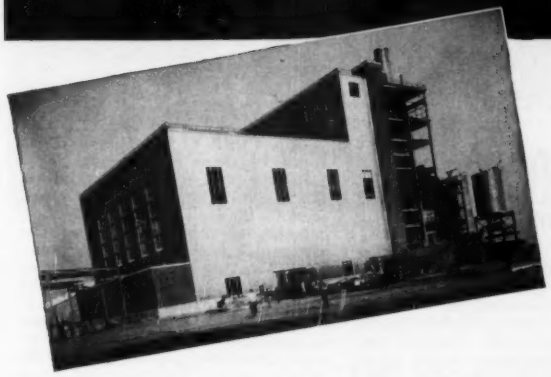
Cost

The cost runs about 45 per cent above that of a conventional single-tube heat exchange. However, if the damage caused by a tube failure is sufficiently large, the additional cost is well justified.—ASME Paper No. 50-A-125.

IMPORTANT FORWARD STEP in the plans of Oliver Iron Mining Co., to tap the vast reserves of low-grade iron ore on the Mesabi Range known as taconite, was taken May 17 when ground was broken for a pilot taconite beneficiation plant with an annual capacity of 500,000 tons of finished concentrates. This plant, first to be built by the Oliver company, will add substantially to the vital supplies of raw materials which the steel industry needs to carry out its national defense program. It is expected that the new taconite pilot plant will be placed in operation during the summer of 1952.

DURAGAUGE *specified . . .*





. . . *another major installation of* ASHCROFT DURAGAUGES

Shown above is the central control room of the new Edge Moor Power Station of the Delaware Power and Light Company now under construction by United Engineers & Constructors, Inc.

Recognized as "the standard of the industry," the Ashcroft Duragauge has an unmatched record of performance in the most severe installations to be found in the power field.

The Duragauge, as engineers will verify wherever it is installed, combines the most modern concepts of design and manufacture with experience that goes back over a century.

THE NYLON MOVEMENT is exclusive with the Duragauge. It provides unprecedented impact absorption, retention of form and shape under high temperatures, low friction, and corrosion resistance.

BOURDON TUBE MATERIALS for every service. These include phosphor bronze, beryllium copper, Monel, alloy steels, and stainless steels 316, 431, and 347.

CASE DESIGNS for any purpose in phenol condensate, "alumalife," iron, and brass. Stem, flush or wall mounting.

ROTARY MOVEMENT DESIGN enables recalibration in the field with maximum accuracy in minimum time.

See your local distributor for the gauge that means lowest maintenance costs—the Ashcroft Duragauge. He invites your inquiries.

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

ASHCROFT *Gauges*

A Product of

MANNING, MAXWELL & MOORE, INC.

STRATFORD, CONNECTICUT

1850 ASHCROFT U.S.A.

Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

Corrected table of Preferred Standards for large 3600-rpm, 3-phase, 60 cycle condensing steam turbine generators.

	Air-Cooled Generator	Hydrogen-Cooled Generator Rated for 0.5 Psig Hydrogen Pressure						
Turbine-generator rating, kw	11,500	15,000	20,000	30,000	40,000	60,000	90,000*	
Turbine capability, kw	12,650	16,500	22,000	33,000	44,000	66,000	99,000	
Generator rating:								
Kva	13,529	17,647	23,529	35,294	47,058	70,588	105,882	
Power factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
Short-circuit ratio	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Throttle pressure, psig	600	850	850	850	(850 or 1250)	(850 or 1250)	(1450 or 1450)†	
Throttle temperature, F	825	900	900	900	(900 or 950)	(900 or 950)	(1000 or 1000)	
Reheat temperature, F							1000	
Number of extraction openings	4	4	4	5	5	5	5	5
Saturation temperatures at openings at "turbine-generator rating" with all extraction openings in service, F								
1st	175	175	175	175	175	175	180	175
2nd	235	235	235	235	235	235	245	240
3d	285	285	285	285	285	285	305	300
4th	350	350	350	350	350	350	380	370
5th				410	410	410	440	440
Exhaust pressure, in. Hg abs	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Generator capability at 0.85 power factor and 15 psig hydrogen pressure, kva	—	20,394	27,058	40,588	54,117	81,176	121,764	
Generator capability at 0.85 power factor and 30 psig hydrogen pressure, kva	—	—	—	—	—	—	132,353	

A tolerance of plus or minus 10 F shall apply to the above saturation temperatures. (Tolerances shall be unilateral so as not to reduce the spread in temperature between adjacent extraction openings.)
The "turbine capability" is guaranteed continuous output at generator terminals when the turbine is clean and operating under specified throttle steam pressure and temperature and 2½ in. Hg abs. exhaust pressure, with full extraction from all extraction openings.

* A 10 per cent pressure drop is assumed between the high-pressure turbine exhaust and low-pressure turbine inlet for the reheat machine.
† These are two different units; the first for regenerative cycle operation, and the second a machine for reheat-cycle operation.

Preferred Standards for 3600-rpm Turbine Generators Revised

Standards sponsored by AIEE and ASME extended to cover the 90,000/99,000-kw size for both straight regenerative and reheat cycle turbine generators

SHORT TIME after the preferred standards for large 3600-rpm 60-cycle condensing steam turbine generators were proposed by a joint committee of the AIEE and the ASME in 1945 and 1946, a detailed discussion of these units by J. R. Carlson was published in the March 1947 issue of *Power Plant Engineering*. When these standards were recommended, the committee considered it inadvisable to adopt any rating as standard larger than the 60,000-kw unit. This was considered to be the largest economical rating with 20-in. last row blades and the largest rating on which there was sufficient operating experience.

However, since 1945 certain factors have made it desirable to revise the earlier standards. Rising coal and labor costs have encouraged use of higher steam pressures and temperatures and units of greater output. Available metals have placed an upper limit on steam temperature and led to wider use of the reheat cycle. Operating experience with hydrogen cooling in generators has made it desirable to extend use of hydrogen to the 15,000-kw rating in place of air cooling.

As of November 15, 1950, the two sponsor bodies of the joint committee have issued a circular giving a new revised Preferred Standards, together with standard specification data on the generators.

The accompanying table includes the data recommended for the new 90,000-kw preferred standard unit, for which two steam conditions are shown:—One for 1450 psig, 1000 F without reheat; the other with reheat to 1000 F. Note also that the 15,000-kw unit has its initial steam conditions changed to 850 psig, 900 F.

Experience with hydrogen-cooled generators has shown that increased capacity may be secured by raising hydrogen pressure to 15 psi. Largest units have generators capable of operating with 30 psi hydrogen pressure.

These points were reviewed by A. G. Christie, Professor Emeritus of Mechanical Engineering, The Johns Hopkins University, now a consulting engineer and member of the Preferred Standards Committee, in the February 1951 issue of *Combustion*.

Professor Christie then went on to discuss some of the work that has been done on international standards for steam turbine generators. He points out that international committees for this purpose were quite active during the 1920's and in 1931 they issued international specifications for the purchase of steam turbines and rules for acceptance tests. These were officially adopted by the then American Advisory Committee, but the date fell during the depression and little publicity was given to these international documents. They appear to have had little influence, says Professor Christie, on American steam turbine sales or development. After World War II, however, further work was done and there was a meeting of representatives of the several national steam turbine committees in London last July, at which the American committee was represented. Work is continuing to revise the international specifications in the light of developments in recent years and especially in the light of the revised Preferred Standards shown here.

EMERGENCY DEFENSE HANDBOOK PUBLISHED

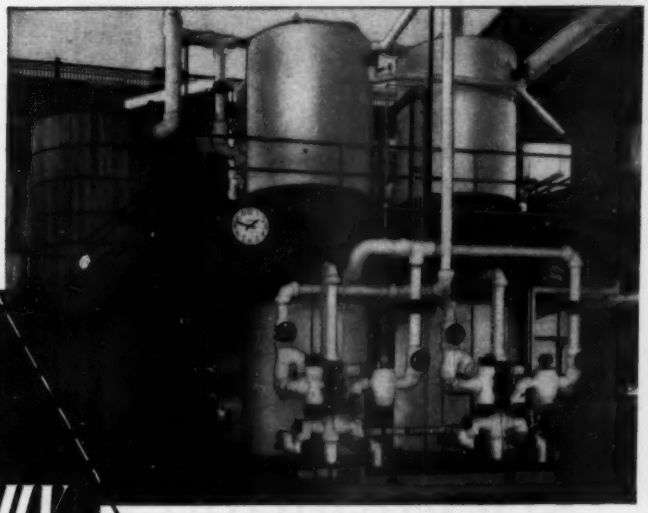
PLANNED TO appear quarterly, a new "Handbook of Emergency Defense Activities" has been issued by the General Services Administration.

The handbook is a guide to Federal agencies, all or part of whose functions are devoted to mobilization or to other related phases of the defense program.

To assist the public in reaching the proper service in connection with the defense program, the handbook presents brief organizational outlines and the names, addresses and telephone numbers of officials of emergency defense agencies and their field offices, together with similar data on the Department of Defense and the U. S. Coast Guard.

For ready reference, there are included a subject index, a name index, a list of commonly used abbreviations for Government agencies, and a separate list of officials from whom information may be obtained concerning additional Federal agencies.

The handbook may be purchased for 25 cents a copy from the Superintendent of Documents, Government Printing Office, Washington 25.



Pioneer Demineralizer Installation—Central Station Makeup

5 REASONS WHY Central Station Shifted from Evaporators to Demineralized Makeup

Early in 1950 INFILCO helped make water treating history. The first complete demineralizing plant ever installed to treat *boiler makeup water in a central station* was put into operation.

This demineralizing and silica removal plant replaces evaporators previously used on three of the most recently installed boiler units. It is expected to eliminate any need for evaporators on a scheduled 1800 psi unit. Treatment equipment consists of three sets of Catex®-Anex® demineralizing and silica removing units with one aerating tower for the removal of carbon dioxide. Infilco "F" Valves afford automatic operation of the demineralizers.

Without obligation, discuss your "power" water problem with Infilco's competent Field Engineers. They are strategically located in principal cities. Or write our executive offices in Tucson. Further data on this "pioneer" installation is available as well as information on other outstanding Infilco water treatment equipment.

1. **ASSURED AMPLE SUPPLY**.. *demineralizers can always operate at rated capacity whereas evaporator output varies with turbine load and evaporator condition.*
2. **IMPROVED QUALITY**.. *demineralized water is consistently low in dissolved solids content and practically free from corrosive CO_2 produced in evaporators.*
3. **LOWER OPERATING COSTS**.. *turbine cycle efficiency so greatly increased that it more than offsets demineralizer chemical costs. Phosphate requirements for internal boiler water control drastically reduced.*
4. **LOWER LABOR COSTS**.. *complete demineralizer plant automatic in operation, except for charging regenerating chemicals.*
5. **LOWER MAINTENANCE COSTS**.. *minimized corrosive CO_2 content reduces corrosion problem throughout the feedwater system, boilers and turbines and eliminates costly evaporator cleaning.*

SERVING THE POWER PLANT FIELD WITH WATER CONDITIONING EQUIPMENT THAT'S

Quality Engineered for Quality Performance

INFILCO INC.

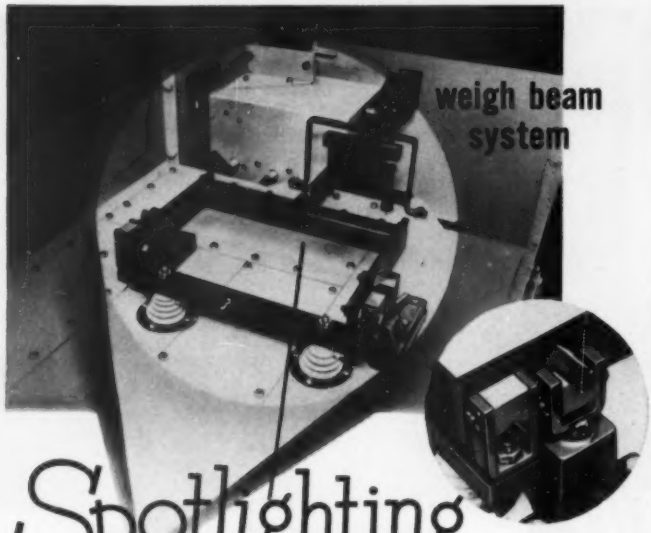
TUCSON, ARIZONA

WITH OFFICES IN PRINCIPAL CITIES

INFILCO

BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT



Spotlighting

ACCURACY in the RICHARDSON coal scale

Another reason why thousands of power installations keep an accurate check on boiler efficiency with Richardson Automatic Coal Scales.

The key to Richardson Scale's reputation for consistent accuracy lies in its Weigh Beam System—the heart of every Richardson Scale. Great strength where strength is needed, sound basic design, and precision construction enable this system to maintain an accuracy of ¼ of 1%. The unit is built of heavy, welded members, free from any tendency to warp or twist with Weigh Beam mounted on hardened steel knife edges, bearing in V-notched, self-aligning, hardened steel blocks. The system is mounted in a separate, dirt-excluding housing to reduce wear and insure long life.

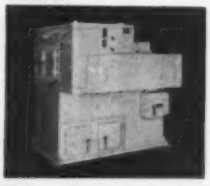
Some other important features that make Richardson Scales the standard of comparison throughout industry are:

QUICK-RELEASE BY-PASS MECHANISM for emergency re-routing of coal direct to stoker or pulverizer.

HINGED LEVELING PLATE to establish a uniform "breakaway" of coal each time the feeder belt is stopped, and to allow passage of occasional large lumps without damage to belt.

DIRECT-CONNECTED DISCHARGE COUNTER to register automatically and unerringly the number of discharges.

ALL ELECTRIC EQUIPMENT mounted outside of corrosive atmosphere of coal chamber.



3 BULLETINS AVAILABLE

Send For Them Today For Complete Information On: EE-39, for dust-tight average service—200-300 lbs. per discharge—**Bulletin No. 0150.**

Model K-39, for pressure-tight (up to 60" of water), large-capacity service—400-500 lbs. per discharge—**Bulletin No. 0250.**

Monorate, non-segregating coal distributor—**Bulletin No. 1349.**

RICHARDSON SCALE COMPANY
Clifton, New Jersey
Atlanta • Boston
Buffalo • Chicago • Cincinnati
Detroit • Houston • Minneapolis
New York • Omaha • Philadelphia
Pittsburgh • San Francisco • Wichita
Montreal • Toronto

Richardson

8104 MATERIALS HANDLING BY WEIGHT SINCE 1902

New ENGINEERING BOOKS

Electrons and Holes, in Semiconductors by William Shockley; First Edition; 558 pages; illustrated; 6½ by 9¼ in.; cloth; D Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y.; 1950; price $9.75.

This book by Dr. Shockley of the Bell Telephone Laboratories is without question the most profound, the most unusual and the most important treatise ever accorded such a negative type of subject as the hole. In common pariance, a hole denotes the absence of something—something that isn't there—and the uninitiated may wonder how anyone, even a Bell Laboratory scientist, could write a book of 558 pages about holes. Indeed, perhaps even more astonishing is the fact that nearly all of the knowledge contained in this remarkable book is relatively new. Practically nothing of it was known 30 years ago. Most of it, in fact, has been gathered and developed in the last decade. Well, then, just what is this book—what is it about?

As the title indicates, the particular holes Dr. Shockley considers in this book have some relation to electrons. Specifically the hole which Dr. Shockley is talking about denotes the place where an electron was.

Now, as is well known, an electron carries a negative electric charge. Indeed, it is considered to be the absolute unit of negative electricity. Therefore, under certain conditions the removal of the electron from a certain locality makes that locality exhibit the effect of a positive charge.

In more technical language the hole or deficit produced by removing an electron from the valence-bond structure of a crystal acts very much as a positive electron.

Although the hole and its negative counterpart, the excess electron, have been prominent in the theory of solids since the work of A. H. Wilson in 1931, the announcement of the transistor in 1948 has given the subject of holes and electrons new technological significance. It is by means of this conception of holes that it has been found possible to explain many aspects of semi-conductor phenomena—that is, the phenomena concerned with transistors and similar devices.

As indicated by Dr. Shockley in the preface of his book, the existence of holes and electrons as positive carriers of current can be inferred directly by the experimental techniques of transistor electronics. As a consequence, the holes and electrons have acquired on operational reality. From the theoretical viewpoint, however, the hole is an abstraction from a much more complex situation and the achievement of this abstraction in a logical way appears inevitably to involve rather detailed quantum mechanical considerations.

So in presenting his subject to the readers, Dr. Shockley divides it into three parts. In Part I, which takes up the first four chapters and 114 pages, only the simplest theoretical concepts are introduced. The main emphasis is upon interpretation in terms of experimental results. These chapters should serve as a basis for understanding the operation of transistor devices and are intended to be understandable by electrical engineers with no knowledge of quantum theory or wave mechanics.

Part III, at the other extreme, is intended to show how fundamental quantum theory leads to the abstractions of holes and electrons. In order to make the spirit, if not the details, of the mathematical investigation accessible to readers an introductory discussion is given in the first two chapters of this part.

Part II attempts to bridge the gap between Parts I and III by presenting the reasoning and results of Part III in pictorial and descriptive terms.

Now, why should anybody, except Bell Laboratory technicians and a few others interested in transistor technology, want to read this book? There are several good reasons. First, to those who display curiosity concerning the workings of nature, it provides a fascinating insight into modern theory of electrical conduction. Secondly, the subject is one which will become of increasing importance to electrical engineers in all branches of the art, because the transistor type of device is going to attain increasing importance as time goes on. Indeed, transistor electronics preceded and, in one respect, always excelled vacuum electronics. The crystal

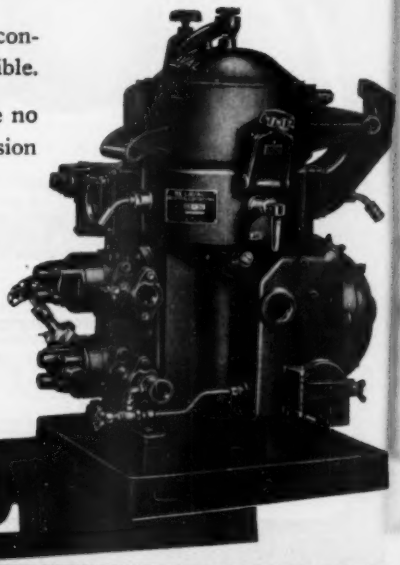
AVOID DOUBLE TROUBLE WITH A DE LAVAL

Dirt and water in your turbine lubrication system are double trouble-makers. Get rid of both of them with a De Laval Oil Purifier and give your turbine ***Double Protection.***

By means of centrifugal force applied effectively in the bowl, a De Laval machine throws out any solid impurities that may be present. Once removed, they cannot build up in the separating zone of the bowl to cause loss of purifying efficiency; they remain packed around the bowl periphery until cleaning time.

Any condensate in the oil is thrown out and continuously discharged. Re-contamination is impossible.

De Laval Purifiers cost little to operate—require no replacement of vital parts—and almost no supervision except cleaning.



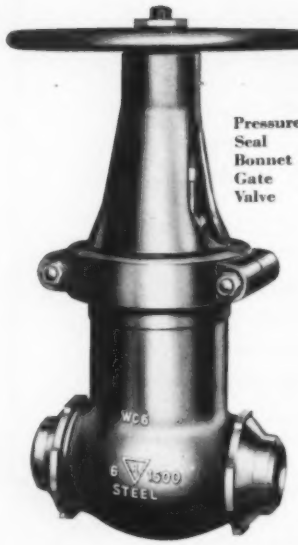
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

for more dependable power production

LUBRICATING OIL PURIFIERS

R·P&C
VALVES



Pressure Seal Bonnet Gate Valve

for High Pressure, High Temperature Service

● R-P&C pressure seal bonnet joint is tight under varying service conditions—is easy to disassemble for inspection—reduces weight.

R-P&C compensating wedge will not stick—opens and closes easier than solid wedge—assures tightness under minor line strains.

Ask your R-P&C *representative to explain the details of these valves*

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

"Intentionally Better"
READING-PRATT & CADY VALVES

wireless detector preceded the audion and it is still the best detector when the going gets tough, as in microwaves. Although just three years old the transistor as an amplifier has already shown strong evidence of its unparalleled usefulness in a variety of applications in the communication art. In the field of electronic computers and in similar applications requiring large numbers of low power amplifiers, transistor devices are being found to have unique advantages. They are tiny, fast and efficient.

It is not often that a subject so new and on which so little has been written should find such comprehensive expression in so excellent a volume. Written in the clearest and most logical terms, this book will serve as a guide for electrical engineers, physicists and students for many years to come because the material presented is of a basic and, therefore, useful nature. The science of transistor electronics which Dr. Shockley and his colleagues have so effectively launched promises to lead into a new era of technology.

● ● ●

Electrical Metermen's Handbook; Sixth Edition; 640 pages; size 6 by 9 in.; bound in flexible fabricoid binding; published by the Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.; 1950; price $4.90.

This Sixth Edition of the Electrical Metermen's Handbook, the first since 1940, has been considerably enlarged, rewritten and revised and reflects the many changes in metering design and practice that have taken place since the appearance of the last edition. The new book represents more than 2 years' work on the part of the Handbook Revision Committee of the Edison Electric Institute's Meter and Service Committee. The aim of the editors has been to make the new Handbook, like its predecessors, a practical guide for experienced metermen, students, meter engineers and supervisory personnel.

The Sixth Edition carries two completely new sections — one dealing with special metering, and the other covering demand meters. There is also an appendix containing material from the Fourth Edition of 1923 showing the essential data for the servicing of older meters still in general use. As in past editions, the new Handbook contains complete tables of constants and register ratio data, diagrams for meter installation and testing, and numerous photographs illustrating meters, the meter shop and laboratory. It should prove an invaluable practical guide to the meterman and meter engineer confronted with the day to day problems of metering customer load.

● ● ●

Radiation Monitoring in Atomic Defense by Dwight E. Gray and John H. Martens; first edition; 122 pages; size 5½ by 8¼ in.; illustrated; cloth; published by D. Van Nostrand Co., 250 Fourth Avenue, New York 3, N. Y.; 1951; price $2.00.

This practical, working manual for radiological defense personnel provides full details on the use of all standard radiation detectors and the interpretation of their results. It is written for everyone concerned with the measurement of radiation, including civilian, industrial and Armed Services defense workers, and requires no technical background to understand or use.

The book has been prepared by two men thoroughly qualified to present reliable, authoritative and dependable information. It is based on the radiological plans and techniques as developed by the Federal Civil Defense Administration and the Atomic Energy Commission.

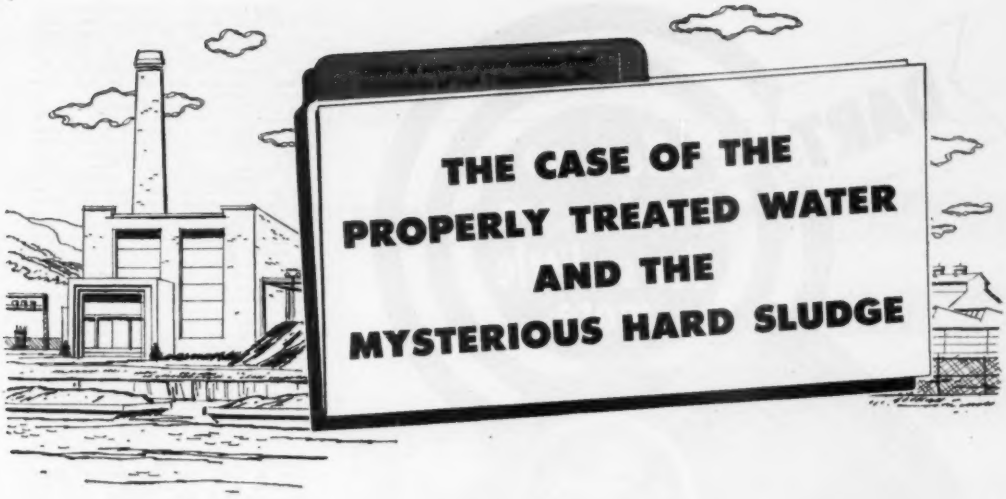
Dwight E. Gray is Chief, Navy Research Section, Library of Congress, formerly affiliated with Technical Information Service of the Atomic Energy Commission. John H. Martens is with the Technical Information Service of the Atomic Energy Commission.

An appendix deals with problems of calibration and there is a valuable bibliography. The entire book is carefully indexed and is arranged throughout for quick and easy reference.

● ● ●

Circuit Analysis of A-C Power Systems, Volume II, by Edith Clarke; First Edition; 396 pages; 6 by 9 in.; illustrated; cloth; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y.; 1950; price $8.50.

This second volume of Miss Clarke's book is a continuation of Volume I, published several years ago. In it, as in Volume I, circuits are analyzed by means of components. The endeavor has been to present methods of procedure in determining the performance of a-c power systems under



THE CASE OF THE PROPERLY TREATED WATER AND THE MYSTERIOUS HARD SLUDGE

The 3-drum, low head 18,000 lb/hr boiler operated at 150 psi had presented no unusual problems in boiler water conditioning, and the routine check by the Hall Service Engineer showed that proper water conditions were being maintained. But—the same inspection also showed a layer of a dense, hard material in the mud drum, underneath the normal soft sludge. The Hall Engineer brought a sample of this unusual substance as well as samples of the soft sludge back to Hall Laboratories for analysis.

As expected, the soft sludge proved to be normal in composition, but the hard material was found to be composed mainly of soluble salts.

The Hall Engineer returned to the plant, and presented the laboratory report to the plant foreman, pointing out that the most probable cause of the condition was heat leakage against the mud drum and suggesting that the asbestos packing between the drum and the bridge wall must have fallen out. Together, they checked the installation, and found the condition which the Hall Engineer had predicted.

The Hall Engineer had realized from the appearance of the deposit that something was not functioning properly; Hall Laboratories supplied exact information on the nature of the deposit; and from this exact information, the imagination and experience of the Hall Engineer enabled him to predict the source of the trouble.

Let Hall Laboratories bring this same sort of teamwork to the study and solution of your specific problem. For more information, clip the coupon.

HALL LABORATORIES, INC.

(A SUBSIDIARY OF HAGAN CORPORATION)

CONSULTANTS ON BOILER WATER CONDITIONING;
PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.
Please send me your bulletin:
☐ Your Most Important Raw Material

Name_____

Position_____

Company_____

Street & Number_____

City_____ Zone_____ State_____

PE-6

2 BRONZE SEATS

No question about it, Darts are made to give extra value — much more for only a little more. Take the seats! They're both made of non-corroding bronze to give resilience and top resistance to corrosion and pitting.

A TRUE BALL JOINT

Then to give perfect contact — the wide-bearing area that locks out leaks — each is precision-machined. And, finally, spherically ground.

HIGH TEST MALLEABLE IRON

The nut of a Dart — as well as both ends — is made from practically indestructible, high test, air-refined malleable iron. It's your guarantee of top resistance to stress, stretching and wrenching.

Insist on Darts. You'll find they *cost* less in the long run.

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART
UNIONS

normal and abnormal operating conditions. The electrical characteristics of insulated cables, various types of transformers and auto transformers, synchronous machines and induction motors are determined with special attention to the development of equivalent circuits for use in the component networks.

Miss Clarke points out that although the greater part of Volume II was written while she was still a member of the Central Station Engineering Dept. of the General Electric Co., much remained to be done after she joined the Electrical Engineering Department of the University of Texas as Professor of Electrical Engineering. And she points out that the delay in the production of Volume II is due in part to the change in point of view from that of an engineer in industry to that of a teacher and to the attempt to make Volume II a textbook for seniors and graduate students as well as a reference for power system engineers.

To those who have followed Miss Clarke's career at the General Electric Co., this book scarcely requires recommendation. It is done with her usual thoroughness for attention to detail and this second volume, together with Volume I, constitutes a valuable and lasting contribution to the art of electrical engineering. It is one of the most thorough and practical treatises on symmetrical and related components available.

• • •

Circuits in Electrical Engineering by Charles R. Vail; First Edition; 560 pages; illustrated; 6 by 8½ in.; cloth; published by Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y.; 1950; price $7.65.

Most of us who studied electrical engineering in college probably can recall the mental hazard that we built up in our mind when we finished the direct current part of the electrical engineering course and took up alternating current theory. Alternating current we had been conditioned to believe was more complex and, therefore, more difficult to understand and it was, therefore, natural that we approached the transition point with some degree of apprehension. And, of course, this apprehension was justified because alternating current was more complex and more difficult.

Later on, perhaps long after we had become familiar with the complexities of a-c phenomena, we learned that in a certain sense direct current was actually only a certain case of a-c phenomena, namely, that of zero frequency.

Of course, the distinction is natural and also chronological, since historically d-c technique was developed before a-c. From a logical standpoint, however, the division is not desirable and it is for this reason that Professor Vail's book on Circuits is a welcome addition to electrical engineering literature. In it, he breaks away from the traditional method of dividing the subject up into separate sections on d-c and a-c circuits. This unified approach provides one set of steady-state circuit principles sufficiently broad to apply to all frequencies to which the circuit viewpoint is applicable, including the zero-frequency case commonly accorded separate treatment under the name of direct current.

A major part of the book is devoted to a study of steady-state principles through the use of the complex number. A considerable amount of attention, however, is also given to a study in terms of instantaneous values of both sinusoidal and non-sinusoidal wave relations, including transient phenomena.

It is essentially a textbook for use in engineering colleges but it should be of equal value to practicing electrical engineers as a reference work. The large number of problems at the end of each chapter add to the book's value in college work.

Professor Vail divides his book into five parts. Part I constitutes a general introduction, discussing the background of electrical engineering, the basic concepts of the electric current, and the use of vectors and complex algebra.

Part II considers simple circuits, series and parallel arrangements, effective current and potential, complex power computations, etc.

Networks are presented in Part III. This includes general sinusoidal steady-state network analysis, couple circuits and polyphase circuits.

Analysis of non-sinusoidal waves is presented in Part IV and the last section, Part V, is devoted to a consideration of transient phenomena.

A short appendix at the end of the book lists useful tables of constants and conversion factors, and there is also a fairly good index.

if you need to control

FLOW

TEMPERATURE

PRESSURE

LIQUID LEVEL

of

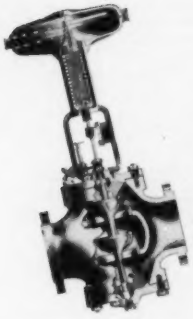
AIR

GAS

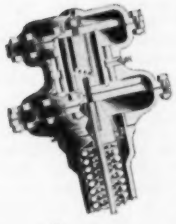
VAPOR

LIQUID

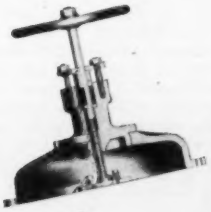
STEAM



A.



B.



C.

you NEED BS&B "Climax" DIAPHRAGM CONTROL VALVES, Type 86. Here is design and engineering that delivers all the characteristics essential to best process control results. High-lift and characterized inner valves obtain wide rangeability and constant proportional flow increase as valve opens.

Complete versatility is yours. Type 86 Valves are available with reversed topworks (A), duplex diaphragm (B), handwheels (C), finned cooling section, purged gland section, bellows stem packing, steam-jacketed valve bodies and valve positioners. Inner valves are quick-opening, parabolic, V-port, needle and metering pin.

Sizes in double port style ½ inch to 16 inches; single port ½ inch to 4 inches. Pressure ranges are 125 to 5000 psi, within body limits.

Get the complete, detailed story today. Write for new illustrated literature with all the facts on these high-performance Diaphragm Control Valves.

BLACK, SIVALLS & BRYSON, INC.
Adv. Dept., Rm. 51R 7502 East 12th St.
Kansas City 3, Missouri

BS&B

"Climax" CONTROLS

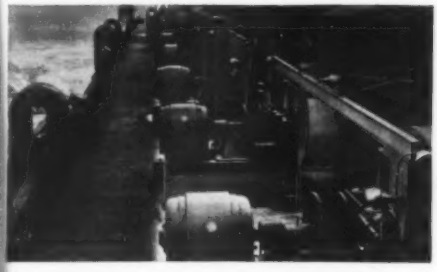
DRAFT FANS GO on GREEN

A Big Draft Job Handled Capably by Green Fans

Twenty-four large Green Fans take care of a heavy draft load at the Venice (Illinois) Plant of the Union Electric Co. of Missouri. Each of six boilers has two sets of Green Fans, each set consisting of one induced draft fan and one forced draft fan coupled to one motor as a unit. With the heavy demands on this station, all boilers are usually in service continuously, thus throwing an unrelenting burden on the fans.

Engineers whose responsibility it is to recommend or accept draft fans for large power plants certainly want efficiency and low operating costs. But they don't overlook the maintenance and replacement angles. They want the sound designs of competent experienced fan engineers. They also want the care in construction that is found in shops of a company that has built up an international reputation as the "authority" on draft fans. They know that such a company will not tolerate sloppy shop work.

Green is this authority on mechanical draft fans.



Have You a Copy of Our Fan Bulletin No. 168? If not, we shall be glad to send you one.

THE GREEN Fuel Economizer COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

NEWS from THE FIELD

WESTINGHOUSE TO BUILD LARGEST 3600-RPM STEAM TURBINE

STEAM DIVISION of the Westinghouse Electric Corp. at South Philadelphia, Pa., has received an order from the Public Service Electric and Gas Co. of New Jersey for a 185,000-kw tandem-compound steam turbine, largest single shaft 3600-rpm turbine ever to be built. The unit will be designed with 25-inch blades, longest ever used, and will be installed at the Burlington, N. J. plant.

The turbine will operate with steam at an initial pressure of 2350 psi and at 1100 F, with reheat to 1050 F, and will be a triple exhaust unit. It is scheduled for shipment early in 1954.

CENTRAL VERMONT PUBLIC SERVICE CORPORATION TO INSTALL TWO GAS TURBINES

A GAS TURBINE power plant is to be built by Central Vermont Public Service Corp., Rutland, Vt. The company has ordered two 5000-kw regenerative type gas turbine generating units from General Electric Co. and has placed a tentative order for a third unit.

First of these units will be on test soon at Schenectady. It is understood it will be placed in service this fall.

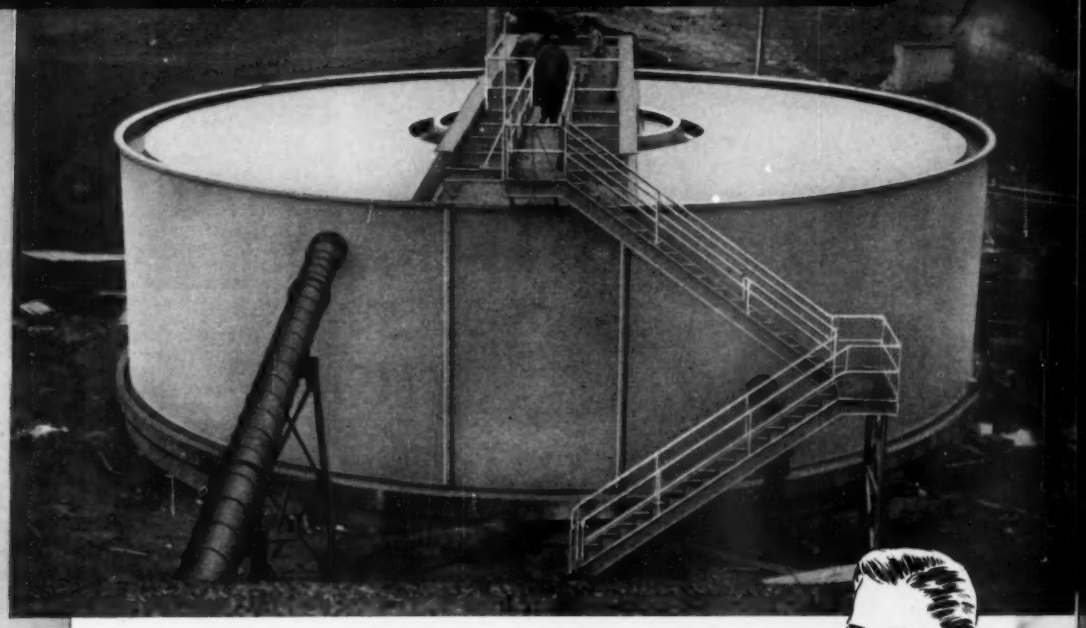
MORE POWER FOR NEW JERSEY

EXPENDITURES totaling approximately $100,000,000 for extensive additions to its electric properties are authorized by Public Service Electric and Gas Co. of New Jersey. This expansion is designed not only to keep pace with the present industrial, commercial and residential demands for electricity in the important areas of New Jersey the Company serves, but it is also in anticipation of future power requirements.

On April 27 the company announced that an order had been placed for a new 185,000-kw turbine generator for its Burlington Station. This will be one of the largest units in the world and will bring the electric generating capacity of that station to 475,000 kw. It is expected to be ready for service in the Summer of 1954.

Installation of a fourth turbine generator unit of 125,000-kw capacity at Sewaren is nearing completion and it is expected that this new unit will be in operation this Fall. Sewaren Station's capacity then will be 455,000 kw. Sewaren, the newest station in the Company's

A *Good* waste-treatment system...



costs *far less* than you think!

HERE'S HOW ONE MAN LEARNED THIS FACT:

A paper manufacturer, faced with the problem of waste treatment in his plant, guessed that a good system would cost him a six-figure sum. To avoid paying so high a price, he sunk a considerable amount into a home-made system—which simply did not do the job. And so he called in consulting engineers.

After making a complete survey of the mill, analyzing samples of its waste, and thoroughly studying the problem, the engineers made their recommendations. They were accepted by the surprised manufacturer, and the system was built.

The waste-treatment plant cost *even less* than the supposedly-cheap makeshift equipment that had failed, and it provided an effluent completely acceptable for re-use in the mill.

It also produced some benefits the manufacturer never expected:

- **A large amount of raw stock was recovered**
- **Stream pollution was eliminated**
- **There was an important reduction in heat losses**

The manufacturer estimates the new system will have paid for itself within three years!

Maybe *you* have been putting off the question of water, sewage, or industrial waste treatment for your plant or community because you think the cost prohibitive. Don't guess; you will probably be wrong! *Call in consultants specializing in this field.*

FREE BOOKLET

FOUR WAYS TO ECONOMIZE ON INDUSTRIAL WASTES ...is a factual treatise offering much useful information on its subject. Write for your copy today! Address: Gilbert Associates, Inc., 412 Washington St., Reading, Pa.

GAI FOUNDED 1906

GILBERT ASSOCIATES, INC.

ENGINEERS • CONSULTANTS • CONSTRUCTORS

READING, PA.

NEW YORK • PHILADELPHIA • WASHINGTON • HOUSTON • ROME • MANILA • MEDELLIN

Steam

plus

CORAVOL

(The Original* AMINE PROCESS)

equals

Protection (FROM CORROSION)

Because CORAVOL Circulates to Control Corrosion

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** *you* will use is formulated to do the best protective job under your own plant conditions.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of chemical treatment for: boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

Chemical Water Treatment

WESTERN CHEMICAL COMPANY

717 Washington Street
Kansas City 6, Missouri

MAIL COUPON TODAY for
Complete Data about the CORAVOL Process

Western Chemical Company,
717 Washington Street,
Kansas City 6, Missouri
Send me full information about CORAVOL.

NAME_____
FIRM_____
ADDRESS_____
CITY_____ ZONE_____
STATE_____

system, was placed in service in 1948 and its initial installation included two 110,000-kw turbine-generator units.

ASME SEMI-ANNUAL MEETING IN TORONTO JUNE 11-14

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its 1951 Semi-Annual Meeting in Toronto, Canada, June 11-14, at the Royal York Hotel. The ASME Ontario Section will be hosts for the meeting. This will be the third national meeting of the Society in Canada, previous meetings having taken place there in 1932 and 1943 when the ASME was a guest of the same section.

The Engineering Institute of Canada will co-sponsor several social events and sessions. Other professional organizations which will participate are the American Rocket Society and the Institute of Aeronautical Sciences. More than 80 papers will be presented in 38 technical sessions.

Papers will be given in the following fields: aviation, fuels, gas turbine power, heat transfer, hydraulics, industrial instruments and regulators, machine design, management, materials handling, metals engineering, petroleum, power, process industries, production engineering, railroad, rubber and plastics, education, and cutting fluids.

An inducement for members and guests to arrive in advance of the meeting will be the Canadian International Trade Fair which will take place in Toronto, May 28-June 8. Thirty-three countries will exhibit merchandise divided into 20 trade classifications.

LINK-BELT APPOINTMENTS

RALPH W. RAUSCH has been appointed consulting engineer of Link-Belt Company, manufacturers of materials handling and power transmission machinery.

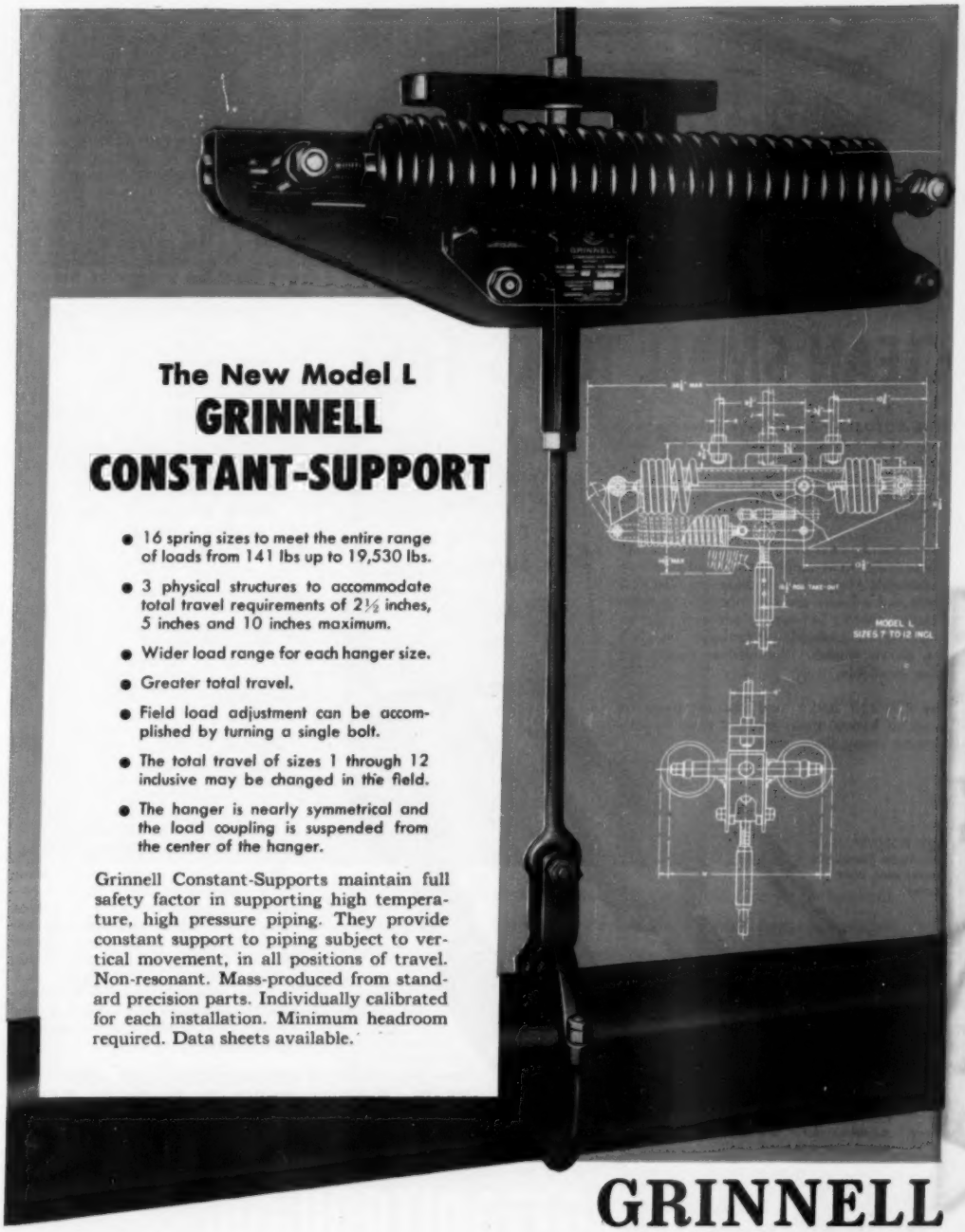
His headquarters will continue to be at the Pershing Road plant, Chicago, of which he became assistant chief engineer in 1933 and chief engineer in 1947.

JOSEPH J. RICHARD, heretofore executive asst. chief engineer of the Pershing Road plant, has been appointed chief engineer of this plant to succeed Mr. Rausch.

ROBERT W. SUMAN has been appointed chief engineer of the company's Philadelphia plant. He has been chief engineer for power transmission products since 1946 and is now assuming the added responsibility of materials handling equipment engineering.

ALLIS-CHALMERS APPOINTMENTS

ANNOUNCEMENT has been made by J. L. Singleton, vice president in charge of Allis-Chalmers general machinery division of two new divi-



The New Model L
GRINNELL
CONSTANT-SUPPORT

- 16 spring sizes to meet the entire range of loads from 141 lbs up to 19,530 lbs.
- 3 physical structures to accommodate total travel requirements of 2½ inches, 5 inches and 10 inches maximum.
- Wider load range for each hanger size.
- Greater total travel.
- Field load adjustment can be accomplished by turning a single bolt.
- The total travel of sizes 1 through 12 inclusive may be changed in the field.
- The hanger is nearly symmetrical and the load coupling is suspended from the center of the hanger.

Grinnell Constant-Supports maintain full safety factor in supporting high temperature, high pressure piping. They provide constant support to piping subject to vertical movement, in all positions of travel. Non-resonant. Mass-produced from standard precision parts. Individually calibrated for each installation. Minimum headroom required. Data sheets available.

MODEL L
SIZES 7 TO 12 INCL

GRINNELL
WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago
Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York
Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

CLEAN SMALL TUBES FAST

With ROTOJET® Junior Tube Cleaners you can clean tubes as small as .495" I.D. quickly and economically. Very little headroom is required for either vertical or horizontal tubes. Tube bundles can be cleaned without removal from shell.

The unusual power developed by the ROTOJET Motor is due to its simple design and exclusive Rotocentric (egg-shape) bore cylinder. A shaft and a blade are the only moving parts. Positive contact between blade and cylinder is always maintained. No leakage. No stalling at low speeds. Water-driven motors are also available.

Try ROTOJET Junior, and you will never go back to heavy, slow, external type cleaners costing many times more.

in
★ BOILERS
★ CONDENSERS
★ EVAPORATORS
★ SUPERHEATERS
and other
★ TUBULAR
APPARATUS

S32 ROTOJET Junior Air-driven Motor, universal joint, cone cutter.

C439 ROTOJET Junior Air-driven Motor, universal joint, drill head

C434 ROTOJET Junior Air-driven Motor, flexible coupling, expanding brush.

C324 ROTOJET Junior Water-driven Motor, univ joint, pivot head

SEND FOR ROTOJET JUNIOR BULLETIN

ELLIOTT COMPANY-ROTO DIVISION
147 Sussex Avenue Newark 1, N. J.

sion appointments—J. F. Roberts as director of engineering, and R. C. Allen as consulting engineer. Both men are widely recognized for their outstanding engineering accomplishments.

ORGANIZATION of a new mechanical power department headed by W. A. Yost has been announced by J. L. Singleton, vice president in charge of Allis-Chalmers general machinery division.

Yost had been manager of Allis-Chalmers steam turbine department since 1947. He came to Allis-Chalmers in 1943 as manager of the department's marine division. From then until 1945, when he was named assistant manager of the department, Yost directed the expansion of Allis-Chalmers normally extensive marine turbine production into a vast World War II output of more than 4,000,000 hp in geared steam turbine propulsion units for combat ships, troop and cargo carriers, repair ships, tankers, and auxiliary ships.

BABCOCK & WILCOX TUBE CO. MAKES CHANGES IN TOP OFFICERS

THE BABCOCK & WILCOX TUBE CO. announced four changes in top executive officers of the company following a meeting of the board of directors last month. Luke E. Sawyer, formerly executive vice president was elected president; Alfred Iddles, formerly president was elected chairman of the board; Isaac Harter, formerly chairman was named a consultant to the company and Edward A. Livingstone, vice president assigned to sales was given broader organizational responsibilities.

SYNCHRO-MASTER COMPANY JOINS PROPORTIONEERS, INC.

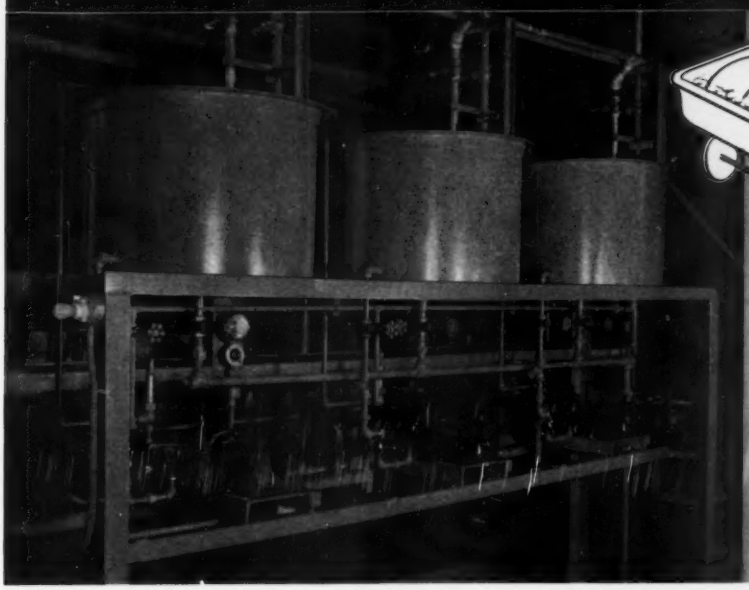
PROPORTIONEERS, INC., Providence, R. I. has acquired Synchro-Master Company formerly of Seneca Falls, New York, and will operate the business as its Synchro-Master Division with sales and production facilities located in Providence, R. I. The key personnel of the Synchro-Master Company has also joined Proportioneers and will manage the new division.

CONNECTICUT LIGHT AND POWER CO. TO INSTALL FOUR G.E. GAS TURBINE POWER PLANTS

FOUR GAS TURBINE power plants, first to be installed in the state of Connecticut, will be placed in service early in 1953 by the Connecticut Electric Light and Power Co., R. H. Knowlton president of CL&P, has announced.

The order for the four gas turbine units, newest type of power generating equipment, has been placed with the General Electric Co. They will be built in Schenectady, N. Y. in a company shop which was

WATER FOR TRIPLE BOILERS INDIVIDUALLY TREATED BY SINGLE PACKAGE



Assembly includes 3 Model SHPM Adjust-O-Feeders—Capacity 7.5 GPH against 225 psig—handling phosphate and sulfite solutions.

This %Proportioneers, Inc.% packaged system includes metering pumps, chemical tanks, motor starters, controls, valves, piping, and all auxiliary equipment — compactly arranged as a single unit. Treating chemicals are fed automatically in proportion to service load on each boiler. This "Triplet Package" is supplied complete — a single responsibility for your chemical feeding system. We can also supply systems for treating one, two—or *any* number of boilers: chemical feeding systems for any power plant from the largest high pressure installation to the smallest low pressure job. For recommendations call in % Proportioneers, Inc. %.

Write for Brochure SM 9020
"Treatment of Water for Boilers" and Bulletin CAT.

% PROPORTIONEERS, INC. %

Write to %PROPORTIONEERS, INC.%, 385 Harris Ave., Providence 1, R. I.

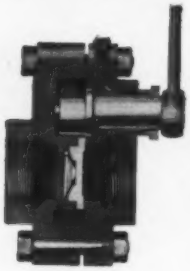
Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

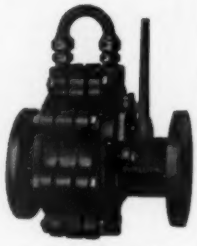
EVERLASTING VALVES

Mean "Everlasting" Protection on these duties

GENERAL SERVICE

Wherever frequent use and quick operation is required for any liquid or gas at pressures up to 300 psi. These valves have outside stuffing box and gland.





STEAM JACKETED

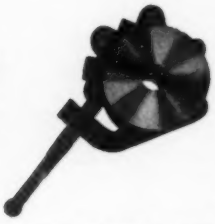
Assure continued free flow of any material which congeals at ordinary temperatures.

FIRE PROTECTION

Closing type for inflammable liquid emergency shut-off, or opening type for deluge or drainage, assuring immediate and positive action with weighted pendulum stop.

BOILER BLOW-OFF

Quick-opening, also handwheel operated Angle and "Y" types and combination units meeting ASME Code requirements for pressures up to 600 psi.



BOILER WATER COLUMN

With indicator and locking device. Meets ASME Code requirements.

EVERLASTING FEATURES

For more than 40 years, EVERLASTING VALVES have been known for their ingenious design, simple, sturdy construction, and long trouble-free life with low maintenance expense. Some of their distinctive features are:

Quick-Action . . . opened or closed with less than a quarter turn of the operating lever.

Straight-Through Flow . . . the disc cannot become loose and accidentally check the flow.

Drop-Tight Seal . . . constant contact of disc and seat at all times prevents dirt or scale from getting between.

Self Regrinding . . . the disc rotates on the seat with each operation, thus regrinding the sealing surfaces.

No Wedge Action . . . all parts move between parallel faces.

Write for bulletin describing EVERLASTING VALVES in detail.

EVERLASTING VALVE CO.

49 FISK STREET, JERSEY CITY 5, N. J.

Everlasting Valves

Trade-Mark "EVERLASTING" REG. U. S. PAT. OFF.

for everlasting protection

newly equipped at a cost of over $4,000,000 for the exclusive production of gas turbine plants.

These four gas turbines, with a total capacity of over 20,000 kw of electric power, will be used for emergency stand-by power and for peak-load service. "They are ideally suited for this kind of operation," said Mr. Knowlton.

* * *

GRAVER WATER CONDITIONING CO., announces the appointment of Flagg, Brackett & Durgin, Inc. as its New England representative.

The executives include Walter E. Flagg, President; W. H. Brackett, Treasurer; Roger G. Bloomfield, Vice-President; E. Peter Garwood, and Arthur D. Durgin, and the staff also includes specialists in boilers and boiler accessories, power plant, oil refining and marine engineering.

* * *

C. B. SCHMIDT has been elected President of The De Laval Separator Company, 165 Broadway, New York, effective April 11th. Mr. Schmidt has been associated with De Laval for the past 29 years. He started with the company as a young salesman at the New York office and was then transferred to the Chicago office. Subsequently he became manager of the Industrial Department at Chicago and following this he served for 14 years as General Manager of De Laval's western division.

* * *

THE HAYS CORP. announces the appointment of John R. Heming to the position of Project Engineer in charge of combustion control.

In his new position Mr. Heming will be in charge of obtaining all engineering data needed to complete control orders; in addition he will handle the entering of these orders. Typical of the products under his supervision are draft, pressure, and fuel-air ratio controllers, complete combustion control systems, meters.

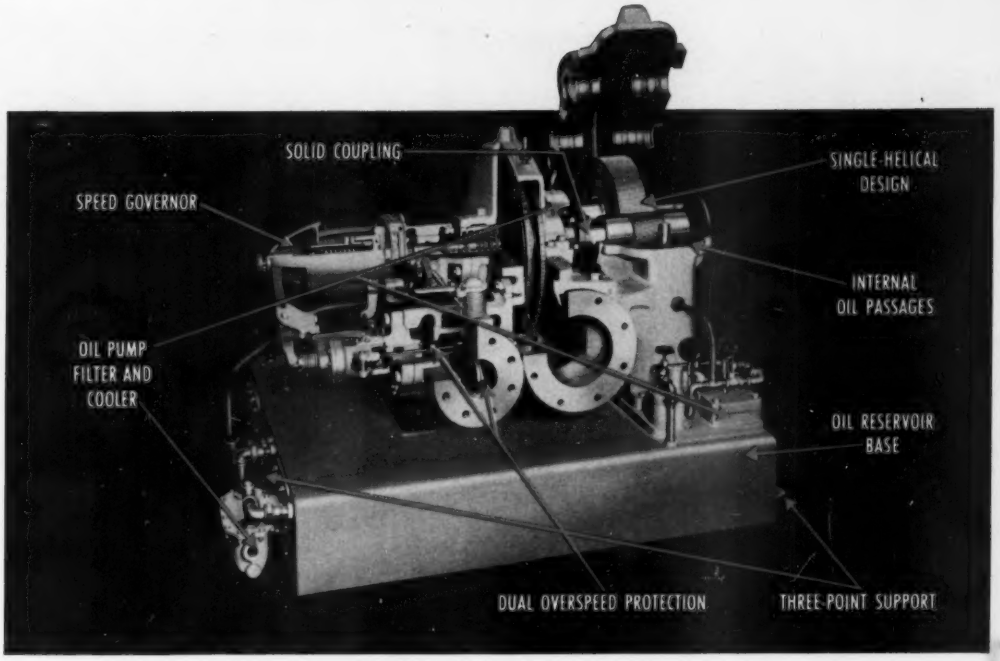
* * *

THE SWARTWOUT CO. announces the appointment, effective immediately, of A. P. Jeffery as power plant equipment sales engineer for the Albany and Schenectady territory. Jeffery, a graduate of Case Institute of Technology, Cleveland, Ohio, will take over his new duties at 11 Dutch Village, Albany 4, N. Y.

* * *

LINK-BELT CO. announces that it has started construction of a modern engineering and manufacturing plant for the production of elevating, conveying and processing machinery, on a 43-acre site at Colmar, Montgomery County, Pa., on the Doylestown branch of the Reading Railway. Colmar is 3½ miles from Lansdale.

The new plant is designed for efficient straight-line manufacture from the receiving department at one end of an 880-ft long building to the shipping department at the other.



TYPE E Gearturbines

Cost Less to Buy . . . Less to Operate

Here's the ideal steam drive for ratings up to 500 hp and output speeds commonly found in single-ended applications such as pumps, fans, compressors, line shafts and generators. It's the Westinghouse Gearturbine that saves you money right from the start. You save on its purchase . . . you save on operating costs.

Save on purchase price because the Westinghouse Gearturbine comes as a complete package. It costs much less than buying a turbine and a separate speed reducer . . . costs less to install, too!

Save on operating costs because every turbine part has been built to give long life and dependable service. An anti-corrosion treatment on vital parts reduces wear and maintenance . . . and there's dual protection against overspeed.

You get these additional features:

Solid coupling of turbine shaft to pinion shaft, makes it easy to align pinion bearings with turbine bearing.

Single-helical gearing; endwise movement of one shaft will not affect axial location of the other. Running clearances are maintained.

Internal oil passages avert accidental damage, improve appearance.

Forced circulation of filtered oil assures thorough lubrication of gears and bearings.

3-point support for maximum ease in leveling and aligning.

Unique oil reservoir forms sturdy base for unit . . . simplifies mounting and installation.

Type E Gearturbines are available in any combination of three wheel sizes, three gears and three types of governor. Your nearby Westinghouse representative has all the facts. Ask him for Booklet B-4346, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50524

YOU CAN BE SURE . . . IF IT'S
Westinghouse
TYPE E
Gearturbines

Pack this ADSCO joint at full line pressure!

Special Piston Rings HOLD line pressure during packing operations

Production is reaching for an all-time high. Costly service interruptions and resulting operational losses must be eliminated! One major cause of down time... cutting off service to repack pipe line expansion joints... *can* be completely eliminated. ADSCO Piston-Ring Expansion Joints can be packed *under full line pressure* with no interruption of service.

ADSCO's patented piston-ring feature... with combined internal guide... holds the line pressure even when the packing is completely removed. Venting the relief chamber exhausts any accumulated steam that may have passed the rings and, with no pressure against the stuffing box, all packing may be withdrawn.

Get these ADSCO extra features

NO SCORING OF SLIP because it is in contact only with the packing. The piston rings ride the machined bore of the body.

COMPLETE GUIDING both internally and externally to prevent misalignment.

SPLIT EXTERNAL GUIDE permits installation in smaller spaces.

LIMIT STOPS prevent over-travel. The slip cannot be pulled from the body while in operation.

PACKING LUBRICATION is provided to prolong packing life and ensure smooth performance of the slip.

NON-FREEZING GLAND STUDS AND BOLTS are of non-corrosive metal and always accessible through special openings in the external guide.

ADSCO Piston-Ring Expansion Joints are available in a full range of sizes, in both single and double units, with 4", 8" or 12" traverse per slip, for pressures to 400 psi and greater, and for temperatures to 750 F. and higher. For information, see your ADSCO representative or *write for Bulletin No. Y-35-15.*

AMERICAN DISTRICT STEAM COMPANY, INC. • North Tonawanda, N. Y.

ANSWER No. 480

(Continued from page 100)

antimony, copper. There may be small quantities of other substances, such as impurities, or added for various purposes. Some high-grade babbitts contain nickel, generally in minute quantities.

In general, it is the hardening element which burns out of a babbitt when it is heated too long, or heated to a too-high temperature. Used babbitt, especially if a lead-base babbitt, will be softer than a new babbitt.

3. Whether a babbitt bearing is poured directly around the shaft, or poured first around a mandrel and then bored to size, depends upon the following factors:

a. If the bearing housing is a part of a machine or engine, and cannot be readily removed for machining, it should be poured about the shaft as the more economic advantage.

b. If shaft cannot be handily removed, pouring of the bearing about it is advisable.

c. If the shaft is tapered or badly grooved, the bearing can be best fitted by pouring it in position.

d. If bearings are in two or more parts, it is frequently advisable to pour each section separately and in position, especially if difficult to machine.

e. All new bearings being fitted to new shafts should be poured about a mandrel, then machined.

f. All small bearings should be poured about a mandrel and then machined, or machined directly from solid stock.

4. Grooves in journal bearings subtract, sometimes appreciably, from the total area of bearing surface. Usually, they are very essential to properly distribute the lubricating oil.

Spokane, Wash. OLIN LEE BRAGE

LARGE ROTATING MACHINES

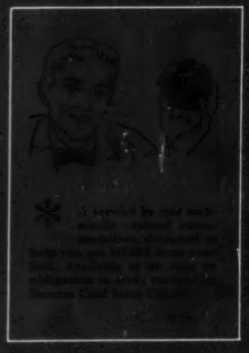
(Continued from page 72)

resistance should be expected of different types of machines. Totally enclosed hydrogen cooled stator windings should have a relatively high level of insulation resistance. A large drop in the normal level of insulation resistance should be seriously regarded as it may be indicative of moisture condensation in the housing which may lead to failure of creepage surfaces. Open type machines, particularly with water spray air cleaners would naturally be expected to have materially lower values. The same value of insulation resistance which would be indicative of hazardous conditions in the closed machine may not be at all alarming on the open type machine. Of these non-destructive tests for testing generator insulation the insulation resistance and the dielectric absorption test appear to have the most merit as an indicator of

is this

YOUR problem?

perhaps **Beacon Combustion Service**



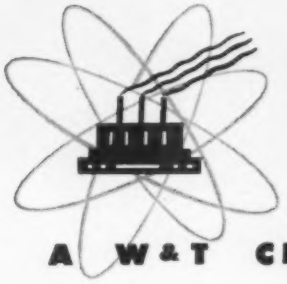
EASTERN GAS AND FUEL ASSOCIATES

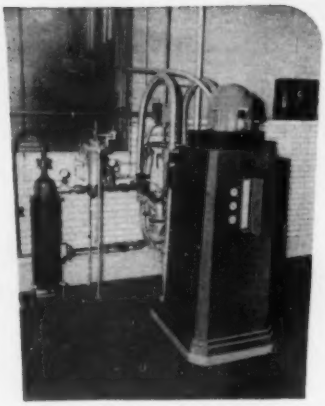
EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH BOSTON CHICAGO CLEVELAND DETROIT NEW YORK
NORFOLK PHILADELPHIA SYRACUSE

For New England: New England Coal & Coke Co., *For Export:* Castner, Curran & Bullitt, Inc.

SAXTON'S SECRET WEAPON . . .





W&T Chlorinator Installation at Saxton Station

A W&T CHLORINATOR

In winning their battle against condenser slime at the Saxton Generating Station, Pennsylvania Electric Company, in their company publication, called the Wallace & Tiernan Chlorinator their "Secret Weapon."

Here's what happened before chlorine was tried. Experience showed even a small accumulation of slime caused a one inch loss in condenser vacuum — equivalent to a five to ten per cent reduction in plant efficiency. Frequent mechanical cleaning — expensive and disagreeable — still left a thin layer of slime. Cleaning compounds involving acids and alkalis were found an unsatisfactory answer to the problem.

Then Chlorine was tried! Preliminary tests indicated that coal consumption could be decreased by about $75 per day. *But,* feeding chlorine without special equipment proved both expensive and dangerous. A slight variation in feed rates resulted either in insufficient treatment or excessive chemical costs.

As a result of these tests, a Wallace & Tiernan Automatic Chlorinator was installed at Saxton in May 1949. This precision chlorinator made possible reduced coal consumption and virtual elimination of mechanical tube cleaning — the reasons why a W&T Chlorinator is Saxton's "Secret Weapon."

Hundreds of power plants have had benefits similar to those at the Saxton Station. Your W&T Engineer is prepared to help solve your slime problems — why not write for more information today — no obligation, of course.

CD-36

WALLACE & TIERNAN
PRODUCTS, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
Belleville 9, New Jersey • Represented in Principal Cities

trends with respect to contamination by moisture of other agents which may decrease either the volume or surface resistivity of the insulation.

Overpotential Tests

Overpotential tests are the only means for providing assurance that the winding insulation has a certain level of insulation strength. Depending on the test value used and the minimum insulation strength of the winding (an unknown quantity) such tests are destructive to a greater or less extent.

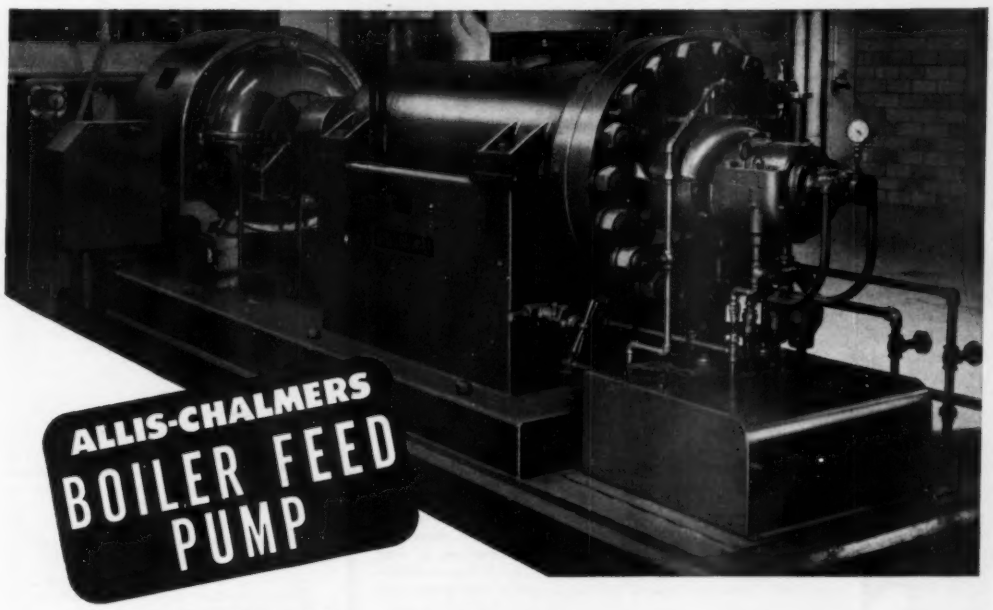
A-C tests nevertheless have been and are being used for maintenance overpotential testing. When used, the test value shuold only be high enough to give assurance of certain minimum required insulation strength. In most cases for relatively infrequent tests a value of $(2E + 1000) \times 65\%$ is believed to be adequate. For relatively frequent tests a somewhat lower value may be desired based on the theory that for shorter times between tests a lower margin over operating stress would be required to give the same over-all safety factor. The application of such a test is a calculated risk which is subject to justification based on the over-all economics of making repairs during scheduled maintenance versus under emergency conditions.

A suitably selected value of d-c overpotential may be equally as searching for likely types of insulation weakness with the expectancy for small or negligible destructive effect on good insulation. There are two reasons for this: 1. An equally searching d-c potential is a smaller percentage of the d-c strength of the insulation than would be the case with comparable a-c stress.

2. Because of the very much flatter voltage endurance characteristic with d-c potentials the time to failure for an equal percentage of one minute strength is far longer with d-c than with a-c potentials.

Accordingly, d-c overpotentials appear to be fundamentally advantageous for maintenance testing. In addition to basic advantages, the required test equipment is much less expensive and far less costly and cumbersome to transport. Also insulation leakage at high stress may be measured. D-C overpotential maintenance tests are therefore recommended. The risk involved in this test is believed to be very much less than with a comparable a-c test.

A d-c test value 1.6 times the recommended a-c maintenance test of $(2E + 1000) \times 65\%$ has been used and is proposed for general consideration. For convenience then this becomes $(2E + 1000) \times 1.04$. The tester used in connection with the Westinghouse Maintenance Inspection Service is a multirange Tekk Corp. high voltage d-c tester. The ranges are 1.5, 15 and 45 KV. It



THESE 7 Features GIVE YOU RELIABILITY, LOW MAINTENANCE

1. Single stage, back-to-back impellers balance axial forces without use of balancing drum. Two impellers in first stage give advantages of double suction at this point.

2. Volute casing provides high efficiency and radial balance. Volute design also simplifies construction for easier maintenance.

3. Expansion joint is brought to outside of pump where leakage may be quickly detected and adjustments made without dismantling the pump. No flexible internal members are required for expansion compensation.

4. Packing is also located where it may be adjusted easily and quickly.

5. Uniform section of both inner and outer casings assures uniform expansion at all points. Expansion stresses are minimized; alignment is held.

6. Casing halves are held together with full hydraulic pressure of the pump assuring a tight seal with a minimum of heavy parts.

7. A carriage which may be attached to the pump body is furnished with each unit. The inner casing may be withdrawn from the outer casing on this carriage, making servicing easy and quick.

HERE IS A PUMP designed to meet the needs of the newer high pressure boiler plants. Efficiency is high, maintenance is low and every feature has a long record of successful application to boiler feed service.

Sizes range from 1200 to 2500 psig and from 300 to 2000 gpm. Allis-Chalmers can supply the complete boiler feed pump installation including pump, motor and control of coordinated design and manufacture.

Get the details on this new boiler feed pump from your Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3407

ALLIS-CHALMERS

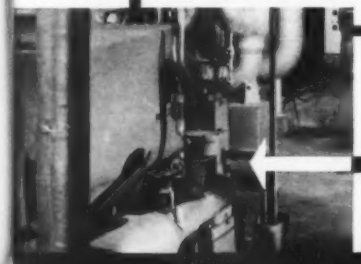
KEEP MAINTENANCE COSTS DOWN ON BOILER FEED PUMPS WITH FOSTER RECIRCULATING VALVES

Burnouts cost money. They can happen when high capacity, high pressure centrifugal pumps are operated at *low output* without protection against overheating. And since there is a *low flow* period every time the pump is started up or shut down, a proper by-pass or recirculating circuit is essential — to provide sufficient flow to carry away the heat generated within the pump.

An automatic by-pass will do more than just prevent burnouts. It will further cut maintenance costs by reducing impeller erosion due to cavitation and excessive entrained air. It will also prevent power waste by automatically cutting out when the flow is high enough.

The Foster Recirculating Valve is power operated, spring loaded, normally open. Air supply to the power head is through a three-way solenoid valve controlled by a switch operated by the pressure drop across a metering element in the discharge line. When the discharge flow is below a satisfactory minimum, the valve stays open, permitting recirculation. It guaranties that the pump will never run dry (have zero flow while running). When, however, the discharge flow is satisfactory, the valve closes, preventing power waste.

The Foster Recirculating Valve can be used in conjunction with any suitable controlling device.



Typical Foster Recirculating Valve installation in a large Eastern Utility. Since the first six were installed in 1937, eighteen more have been installed as standard equipment to protect boiler feed pumps.

FOSTER ENGINEERING

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS . . . SAFETY VALVES . . . FLOW TUBES

is essentially a low energy device having a maximum output of 2.5 milliamperes.

Slot Discharge Analyzer

The slot discharge analyzer is a single purpose instrument. It is used for checking the adequacy of the grounding between the low resistance conducting coil surface in the slot portions and the core. This equipment is effective in detecting and locating the presence of surface discharging from low resistance areas of coil treatment and core. Detection is accomplished by a simple test from machine terminals. If line terminal checks indicate existance of discharging, affected coil sides are located by probing coil surfaces at accessible areas such as in vent ducts.

Surge Induction Tester

The surge induction tester provides a means of checking the conductor insulation of wound machines. This equipment is used in the factory for testing multi-turn half coil designs where previously no method was available for testing conductor insulation at half coil joints. The present equipment induces surges up to approximately twice normal operating stress.

GOOD INSTRUMENTATION AND CONTROL

(Continued from page 79)

makeup are often required, extensive water treating is often necessary.

Higher ratings and pressure, under fluctuating loads, usually justify the best type of feedwater regulation. The three-element control involving steam flow, water flow and water level is becoming very popular for this type of plant. Large amounts of fuel consumed, and need for following load fluctuations, make a complete combustion control system, capable of operating the boiler through the required load range with maximum efficiency, an economic necessity for boilers of this size. See the table for recommended instruments.

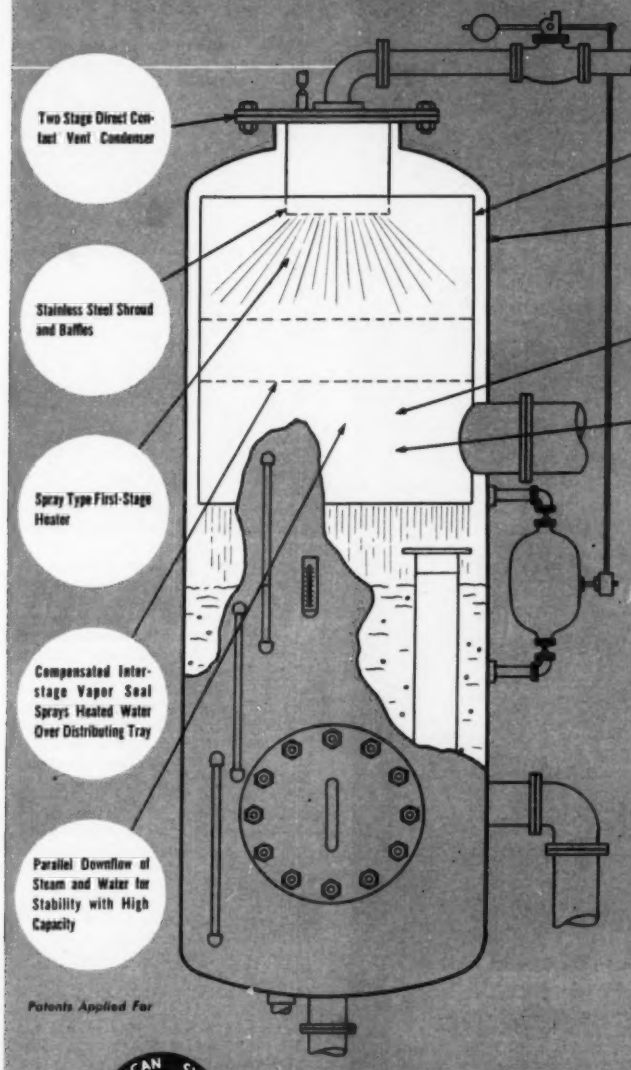
Where different fuels, or mixtures of different proportions are burned, an analyzer for free oxygen in the flue gases is valuable, since it is least affected by changes in fuel composition, whereas the older CO_2 analyzer is of little value because of the large variation in CO_2 content when burning different fuels with the same excess air.

Controls for Small Steam-Electric Generating Plants

Trend of design in smaller steam-electric generating station is toward the unit type of plant with centralized control of mechanical and electrical equipment. John M. Drabelle, chief engineer of Iowa Electric Light & Power Co., comments:

"Three outstanding items deter-

The American Deaerator... Pacesetter


Two Stage Direct Contact Vent Condenser
Stainless Steel Shroud and Baffles
Spray Type First-Stage Heater
Compensated Interstage Vapor Seal Sprays Heated Water Over Distributing Tray
Parallel Downflow of Steam and Water for Stability with High Capacity
Heating and Deaeration Performed Within Inner Shell
Pressure Shell Protected From Highly Contaminated Vapors
Stainless Steel Deaerating Section
More Surface and More Turbulence Than Any Other Deaerator

Patents Applied For

50 Years of manufacturing water treatment systems mark American a leader . . . by proven experience . . . by progressive engineering . . . by industry acceptance.

The American system of Deaeration, for the removal of free oxygen and other gases from boiler feedwater, for prevention of corrosion to feed lines, stage heaters, economizers and boilers, is designed in this American tradition.

American apparatus embodies the most progressive design elements found in Deaeration equipment today. It sets the pace for modern industrial demands.

We invite your inquiry. Write for Bulletin 116.

AMERICAN SYSTEM AWS PATENTED

The AMERICAN WATER SOFTENER COMPANY

LEHIGH AVENUE & FOURTH STREET • PHILADELPHIA 33, PENNA.

FILTERS • SOFTENING SYSTEMS • CHEMICAL FEEDERS • ION EXCHANGERS • RE-ACTORS • SWIMMING POOL EQUIPMENT • DE-GASIFIERS • WATER TEST SETS • RE-CARBONATORS • ALKALIZERS

...another outstanding
NEW "JOHN CRANE"
SEVERE-DUTY
PACKING

Construction: Dry graphite lubricated, closely braided jacket of top quality asbestos yarn with inconel wire insertion in each strand. Core consists of long fibre asbestos and flake graphite.

177AI is furnished only as die-formed rings, in either square cross-section or with special bevels for concave-convex nest sets.

177AI—for EXTREME PRESSURES, TEMPERATURES to 1200°F

If you have a high temperature packing problem on steam valves, soot blowers, gauge glass fittings, etc., you need this new "John Crane" packing. It remains resilient at high temperatures, it will not harden, even at 1200°F, and it easily withstands pressures as high as 2000 psi.

Style 177AI is the newest in the extensive "John Crane" line of quality packings. If you don't have the complete "John Crane" catalog, you should write for it—its recommendations can be a real help.

JOHN CRANE
CRANE PACKING COMPANY
1811 BELLE PLAINE AVE. • CHICAGO 13, ILLINOIS

mine the cost of the station: invested capital, labor, and taxes. Labor is a never-ending operating charge. When compared to other stations of conventional arrangement, the stations using centralized control used 25 to 50 per cent fewer operating employees, an annual saving that cannot be overlooked."

One of the earlier small utility plants in which controls for boilers and turbines were centralized is shown in Fig. 5.

In more recent installations, the tendency has been to combine mechanical and electrical controls for two units at one supervisory control station. The author showed how this was done for two 50,000-kw, 850-psi, 500-F units at Mustang Station of Oklahoma Gas & Electric Co.

INTERCOOLING SUPERCHARGED FOUR-CYCLE DIESELS

(Continued from page 69)

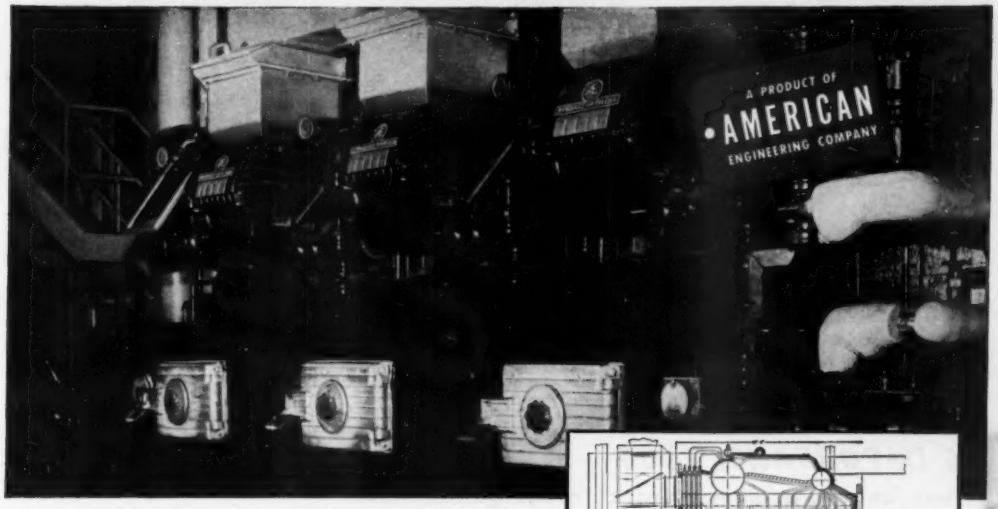
in. supercharged and intercooled Nordberg Diesel engine, operating at 300 rpm, has been in service since 1946. The eight cylinder, 9 by 11½ in. supercharged and intercooled Nordberg Diesel at Owens-Corning Fiberglas Corporation develops 720 hp at 720 rpm.

At the Arizona Edison Company plant at Miami, Arizona, power losses due to both high altitude and high temperatures were compensated by the use of intercooling in conjunction with a slightly higher supercharged pressure. These engines (Fig. 1) are installed at an altitude of 3500 ft which would normally require that they be derated 8 per cent due to the lower density of the air. An additional loss of 4½ per cent results from air temperatures of 105 F during the summer. To compensate for these losses totalling 12½ per cent of the engine ratings, superchargers were designed to give a higher manifold pressure. While the higher supercharger pressure restored manifold air density to sea level conditions it caused the air temperature in the intake manifold to increase to 188 F which would cancel all of the benefits of the higher pressure. An intercooler using 125 F water reduced the manifold air temperature to 140 F. With air density and temperatures restored to normal sea level conditions no derating was necessary. The same intercooler supplied with 90 F cooling water would permit rating the engines at 10.5 per cent above normal rating for 90 F air and sea level conditions.

There are many applications where intercooling can be used to provide an increase in horsepower at small additional cost and without any increase in space or foundation requirements. Water for intercooling can be either fresh or sea water. The latter is particularly advantageous where engines are installed on tidewater in tropical climates.

Merck & Co. Inc., get 85% boiler efficiency with

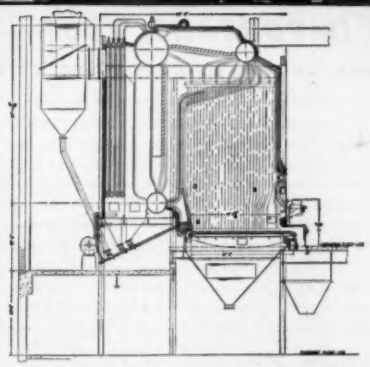
PERFECT SPREAD STOKER



TEST RUN of a recent Merck installation shows an actual boiler efficiency of 85% operating at average load of 71,500 lbs. per hour. The combination of a modern boiler and a Perfect Spread Stoker permits the use of economical high ash coals and assures big annual savings in fuel costs.

Perfect Spread Stoker burns high and low ash coals with equal facility. Its unique feeder provides positive, continuous coal feed and even distribution. *It never clogs on wet coal.* Its fly ash reinjection and adjustable overfire air system brings maximum fuel economy. And Perfect Spread has a capacity range from 8,000 to 500,000 lbs. of steam per hour. With individual capacities from 50 lbs. to 7500 lbs. of coal per hour, the chain conveyor feeder eliminates puffs of smoke common to slug stoking.

Send for booklet fully describing the Perfect Spread Stoker. And if you are considering boilers in capacities from 300,000 to 500,000 lbs. of steam per hour, call us in to discuss cross-firing.



Edge Moor 3-drum boiler fired by 3-feeder Perfect Spread Stoker with traveling grate. Design engineers, Smith, Hinchman & Grylls, Inc.

WON'T CLOG ON WET COAL

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2408 Aramingo Avenue, Philadelphia 25, Pa.

Gentlemen: Kindly send me free copy of Perfect Spread Stoker booklet ( ). I should like to discuss cross-firing ( ).

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

UNIVERSITY OF IDAHO

(Continued from page 76)

gallery by means of a short ascending stairway. The basement and all galleries are connected by steel stairs arranged as conveniently as limited space would permit. The steam jet ash ejector is arranged so that ash refuse can be removed from all of the steam generators in the plant.

MAJOR ITEMS OF EQUIPMENT

COMBUSTION ENGINEERING TYPE VUH STEAM GENERATOR

Designed Pressure, psig	200
Rated Capacity, pounds of steam per hour at 160 psig	40,000
Heating Surface in boiler proper, square feet	5,408
Heating Surface in water walls, square feet	552
Heating Surface in air preheater, square feet	1,200
Furnace Volume, cubic feet	1,845

COMBUSTION ENGINEERING TYPE SPR CLASS II SPREADER STOKER

Three units, each 20 in. wide with power dumps	
Total grate surface, square feet	111.6

FANS AND BLOWERS

Clarage induced draft fan driven by a Whiton type BT steam turbine.	
Horsepower	26
RPM, Turbine	3,600
RPM, Fan	1,330
Turbine exhaust pressure, psig	7
Clarage forced draft fan driven by a Whiton type BT steam turbine.	
Horsepower	11
RPM, Turbine	3,600
RPM, Fan	1,715
Turbine exhaust pressure, psig	7

MARION MACHINE AND SUPPLY COMPANY TWO-ROLL CRUSHER

Capacity, tons per hour	25

UNITED CONVEYOR CORP. 6-INCH NUVEYOR ASH AND FLY ASH CONVEYOR

Capacity, tons per hour	6

BOILER FEED PUMP

Goulds Centrifugal Pump

Capacity, gpm	170
Head, feet	551
Speed, rpm	3,600

Westinghouse Steam Turbine

Horsepower	50
Speed, rpm	3,600
Initial Pressure, psig	160
Back Pressure, psig	7

PERFORMANCE DATA

COAL USED: The guarantees were based on coal from the Bear Creek Mines, Carbon County, State of Montana. Typical characteristics as received are:

Screen size	1½ by ½ in. washed stoker
Heating value	10,589 Btu
Fusion temperature of ash (fluid temperature)	2025 F
Fixed carbon, per cent	43.80
Volatile matter, per cent	37.94
Ash, per cent	9.07
Moisture, per cent	9.19

	Predicted	Actual
Per cent of rating (approximate)	80	80
Steam per hour, lb	32,000	30,308**
Steam pressure in boiler drum, psig	160	160.4
Feedwater temperature, F	225	192.3
Quality of steam, per cent	99	98.83
Exit gas temperature from air heater, F	385	395
Heating value of fuel as fired, Btu	10,589	10,664
Over-all efficiency, per cent	83.08*	81.2*

The unit was found to perform acceptably at 50 per cent rating, 80 per cent rating and 100 per cent rating. Acceptance was based upon performance at 80 per cent rating.

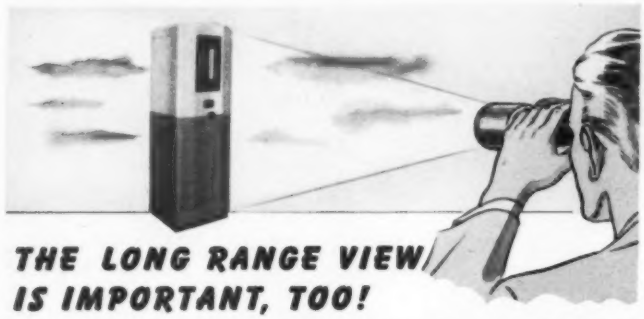
* The specifications required the over-all efficiency at 80 per cent of full load, viz. 32,000 lb per hr to be 81 per cent. The contractor predicted the efficiency to be 83.08 per cent which was 2 per cent above that actually obtained. Several tests were conducted to verify the figure.

The assistance of Mr. David Radscliff, Heating Plant Superintendent, in preparing the foregoing report is gladly acknowledged.

** The water evaported during the tests was measured in calibrated tanks. Temperature corrections were made in computing weights.

* * *

WARREN STEAM PUMP CO., INC., announce that they will be represented in Louisiana, Mississippi, and Alabama, together with sections of Florida and Arkansas by Betz Engineering Sales Co., 1225 Magazine St., New Orleans. They also appointed Harry W. Faunt Le Roy & Associates, Standard Oil Building, Balti-



THE LONG RANGE VIEW IS IMPORTANT, TOO!

when buying or specifying chlorine gas feeders

In other words, how will the chlorinator stand up under continuous use?

Here's where BUILDERS VISIBLE FLOW CHLORINIZERS shine. Due to their unique design, these chlorinators meter and control chlorine gas in the dry, non-corrosive state. Dry, non-corrosive gas as it comes from the cylinder is regulated, controlled, and metered before it enters the bell jar where it first comes in contact with water. As a double protection, the chlorine control valve is lined with porcelain enamel and has a Tantalum diaphragm with silver valve seat and needle — materials that are completely unaffected by dry chlorine gas and highly resistant to moist chlorine gas.

Another feature is the unitized construction of Builders Chlorinizers. These chlorinators are built of separate assemblies . . . simple, integral units — easy to maintain, easy to replace. For complete information and Bulletins, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 385 Harris Ave., Providence 1, R. I.

BUILDERS makes a complete line of flow meters and controllers for liquids, steam, air, gas, and dry materials . . . mechanical and differential . . . including The Venturi Meter and Chlorinizers (chlorine gas feeders).

BIF INDUSTRIES

BUILDERS-PROVIDENCE

BUILDERS

Now get better results from poor fuels!

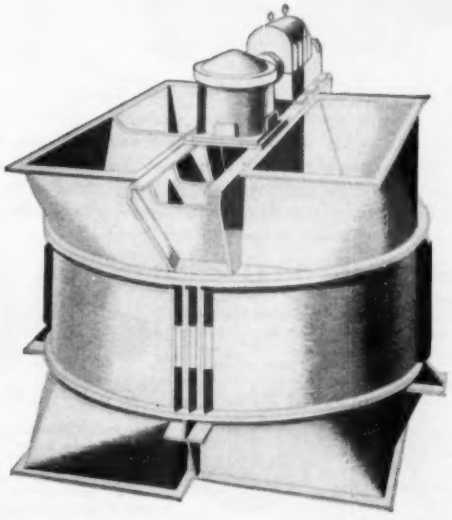
The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

Problems presented by today's available fuels hold fewer complications in those boiler plants equipped with Ljungstrom Air Preheaters.

High temperature combustion air is the key factor to efficient combustion of low-grade fuels, especially coals with high ash or moisture content. With the Ljungstrom Air Preheater it is possible to obtain higher preheat more economically.

In addition, the *continuous regenerative counterflow principle* of the Ljungstrom permits reliable operation at low exit gas temperature. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

If you are planning a new installation, or modernizing your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can enable you to get better results from low-grade, less costly fuels.



THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

more, as their agents in the Baltimore area. The Faunt Le Roy organization has had many years of experience in the pumping equipment field and are in close contact with local industrial activity.

* * *

A NEW DISTRICT laboratory has been opened by Dowell Inc. in Midland, Texas, to operate as a branch of the main Chemical Research Laboratory in Tulsa. The laboratory is fully equipped for complete testing of all types of oilfield samples such as cores, cuttings, brines and paraffins, as well as industrial scale samples. James O. Means, who has been employed as a Research Chemist in Tulsa for several years, has been transferred to Midland to be in charge of the new laboratory.

HELPFUL BULLETINS

(Continued from page 46)

er, a constant voltage type and a midget circuit testing ohmmeter, giving specifications, facsimile scales. Includes current price list. James G. Biddle Co.

129 Centralizing Motor Control — Illustrated Bulletin B-4213, 28 pp, presents modern control centers which feature increased safety and operating efficiency and easier installation and maintenance. Explains how flexibility is gained both in starter unit and in later additions. Mechanical features, wiring and maintenance are described, safety aspects stressed. Basic types are pictured, planning tips and typical specifications included. Industrial Control Div., Westinghouse Electric Corp.

130 Aeronautical Obstruction Lighting —This booklet (Supplementary Sections 9 and 10 to Catalog 50) contains 36 pp of information on use of disconnecting and lowering hangers with fixed position aeronautical obstruction lights. More than 50 photos and diagrams show typical installations of hangers and two-gang obstruction lights and 300 mm code beacons for use with them. Installations on all types of smoke stacks, water tanks, and other structures to 400 ft in height are covered. CAA requirements for lighting of structures considered hazardous to aircraft are listed. Also includes installation instructions, tables of material requirements. The Thompson Electric Co.

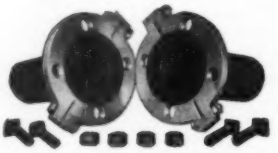
GOODALL
EXPANSION JOINTS
Right-Angle or "FLANG-LOK"

For All Standard Iron Pipe Sizes From ⅜" to 96" I.D.

In both Right-Angle and "Flang-Lok" styles, Goodall Expansion Joints are built with the exacting care that assures the utmost in durability, efficiency and safety under all service conditions. Long experience guides the selection of materials from which they are made; and craftsmen specialists apply unequalled skill to every detail of construction. Used under pressure, vacuum or both, they will stand repeated flexing, with maximum resistance to cracking and "setting."

Advantages of "Flang-Lok"

The combination of "Flang-Lok" End Expansion Joints and "Flang-Lok" Floating Flanges assures quick, easy installation even in extremely "close quarters." It is only necessary to turn the flange (not joint or pipe) to align bolt holes with connecting flange. As flange bolts are tightened, rubber end of joint is compressed over a broad area of connecting flange, providing a leak-proof seal having the widest margin of safety against rated pressures.



"Flang-Lok" Flanges are of cast iron or steel, and drilled to conform to A. S. A. drilling templates in 1" and larger. They are split type, with segments readily bolted together over end of joint, in preparation for actual connection. Design covered by U. S. Pat. No. 1883086.

Contact Our Nearest Branch for Complete Information

GOODALL RUBBER COMPANY

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

Branches: Philadelphia · New York · Boston · Pittsburgh · Chicago · Detroit · St. Paul · Los Angeles · San Francisco · Seattle · Portland · Salt Lake City · Denver · Houston · Distributors in Other Principal Cities

Est. 1870

MECHANICAL POWER TRANSMISSION

131 Improved Drive — Sixteen-pp Catalog C 72-51 introduces manufacturer's Hy-Vo drive designed for maximum load carrying at both high and low speeds. Explains and illustrates how drive's principle of joint articulation and tooth engagement greatly reduces chordal action. Other advantages —lowering operating temperature, reduced vibration and noise and higher speeds—are described. Includes Hy-Vo chain data, service factors, capacity ratings. Discusses simple installation, lubrication. Morse Chain Co.

132 Blocks and Sheaves—Catalog 300-24, 24 pp, covers a complete line of blocks and sheaves. Provides block number, capacity in tons, number of sheaves, rope size and weight of each block. Illustrations, ratio table and formula included in a section on figuring line parts, are intended to make reeving and line part figuring easy for riggers. American Hoist & Derrick Co.

COOLING

133 Pre-Fab Cooling Towers—Here's a 16-pp brochure covering cooling towers furnished in pre-fabricated sections for field erection to specific requirements. Design features that contribute to greater structural strength and lower operating costs are pictured and described briefly. Economy of pre-fabrication is explained. Hudson Engineering Corp.

134 Freon Coolers—Catalog Section 101, 12 pp, is devoted to freon or ammonia coolers of the dry expansion type. In addition to describing and illustrating company's standard line, catalog contains charts and tables showing cooling surface required for 2 to 232 t of refrigeration at water flow rates from 15 to 575 gpm, and for various baffle spacings in single and two-circuit designs. A log mean temperature table, cooler selection data, dimensions, pressure drops and typical piping arrangements are included. Patterson-Kelley Co., Inc.

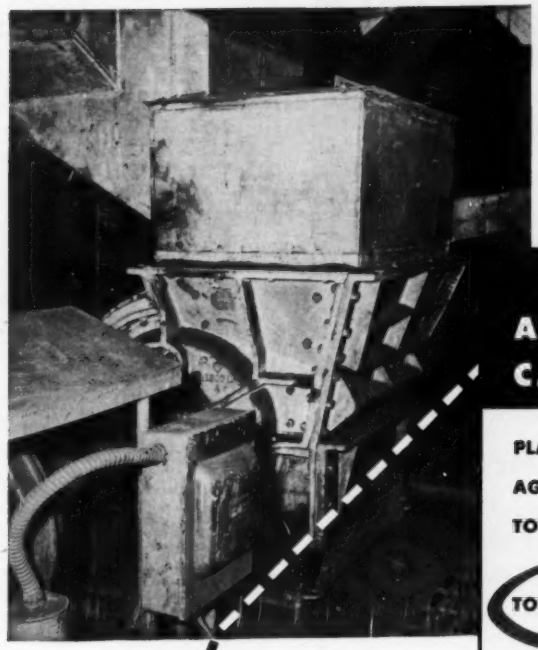
135 Improved Cooling Tower—This bulletin describes cooling towers in which the packing bed is of berl saddles, formerly used in scrubbing towers. These corrosion resistant ceramic saddles provide increased surface area in relation to total volume. Also tells how their use permits reduction of tower heights and pumping horsepower. Technical data and specimen cooling tower problem are presented. Aqua-Therm, Inc.

DUST CONTROL

136 Dust Precipitators—Twelve-pp Bulletin 1728 covers manufacturer's latest design of dust precipitators—a line designed to handle fly ash, cinders and industrial dusts, to meet need for a compact, simple, economical, all-purpose mechanical type unit. Explains and illustrates operation of precipitator. Includes performance and efficiency curves, diagrams of assembly arrangements, also dimensions and physical data. American Blower Corp.

137 Electronic Air Cleaner — Eight-pp Bulletin SA-6091 describes manufacturer's Precipitron electronic air cleaning

These "CRUSHING" FACTS



Another
American Crusher
CASE HISTORY

PLACE: Illinois Coal Mine

AGE OF CRUSHER: 14 years

TOTAL TONNAGE CRUSHED: 1,472,805

TOTAL COST PER TON: one half of 1¢*

...again prove
AMERICAN CRUSHER performance

*

The total cost figure for the 14-year coal crushing operations of the Illinois coal mine, whose American Crusher record is shown above, includes: original cost of crusher (completely depreciated); plus cost of replacement parts; plus maintenance costs; plus interest on original investment (at 3% for 14 years).

But here is the really significant fact: an independent survey of users of American equipment has shown that this performance record is a typical one for Americans—a consistent pattern of high tonnage reduction at remarkably low parts-replacement cost.

Only such features as the exclusive Crushing Ring Design—originated and perfected by American—could reduce coal in power plants and coal mines across the country year after year, ton after ton, for *less than 1¢ per ton.*

Find out how you may reduce the cost of your own crushing problems.
WRITE for detailed information and illustrated literature.

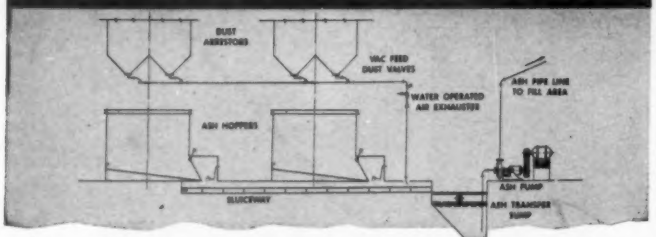
American

Originators and Manufacturers of Ring Crushers and Pulverizers

1429 Macklind Ave.
St. Louis 10, Mo.

Need Large Capacity Ash-Handling?

CHECK WITH BEAUMONT ON A HYDRAULIC ASH-HANDLING SYSTEM



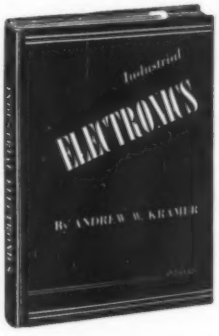
A Beaumont HYDRAULIC System is particularly suited for high capacity ash-handling; handles wet ash or dry, molten slag and large clinkers; fits any type of power plant arrangement; is completely enclosed, preventing dust or gas from escaping to the boiler room; and can be operated by one man on a part time basis.

Beaumont's Ash-Handling Division is competently staffed to give you expert recommendations on all types of ash-handling systems . . . and to provide and install the proper equipment to suit your particular requirements. Write today for the Beaumont brochure: "Answers to Your Ash-Handling Questions".

Beaumont BIRCH COMPANY

1503 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS



a practical new book about Electron Tubes

. . . what they are

. . . how they work

. . . how they can be used

. . . what they can mean to you

INDUSTRIAL ELECTRONICS

by Andrew W. Kramer

This new book explains in clear, simple, non-technical style the basic principles of electronics, and how these principles can be applied in industry. Electronics has been solving the unsolved problems. Whether it is navy beans, opening doors at a shadow, or measuring the thickness of red-hot steel plates, the electron is the newest and most efficient force captured by science. This book should be invaluable for the practical maintenance or operating executive or engineer. 311 pages, 229 illustrations, $6.00.

CHAPTER HEADINGS: Electron Behavior. Fundamental Principles of Electron Tube. The Simplest Thermionic Tube—the Diode. The Triode. Further Aspects of Triode Characteristics and Operation. Electronic Generation of Electric Oscillations. Multielement Tubes. Effect of Gas in a Tube. Types of Characteristics of Gas-filled Tubes. Mercury-pool Tubes. Photoelectric Tubes and Cells. Cold-cathode Tubes. Special-purpose Tubes. What Tubes Can Do. Electronic Control and Regulation. Application of Electron-tube Rectifiers. Electronics in Instrumentation and Measurement. Industrial Applications of Electronic Control. Application of Electronic Regulation. Electron Tubes in Light Production. Miscellaneous Electronic Applications.

Send Your Orders to

BOOK DEPT. POWER ENGINEERING

110 S. Dearborn St. Chicago 3, Illinois

unit. Explains and illustrates how it works, why it cleans air efficiently, where it can be used to advantage, how it's built, and what type to select for a given job of air cleaning. Sturtevant Div., Westinghouse Electric Corp.

TUBING

138 Life Extension for Condenser Tubes—This 32-pp extensively illustrated booklet reports on research into causes of corrosion and means of combatting them, as well as choice of condenser tube materials. Points out that Admiralty metal, long the standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances to assure longer life and reduce maintenance and replacement costs. Includes useful table of estimating data for condenser, heat exchanger tubes in various alloys. Revere Copper and Brass, Inc.

139 Tubing Steels for Severe Service—Condensed technical information on tubing used in high temperature and high pressure applications is contained in 6-pp Technical Bulletin 12F. Contains analyses, physical and mechanical properties, creep strength, short time high temperature tensile strength, and oxidation resistance of 14 popular tubing steels. Includes data on carbon, intermediate chrome moiybdenum and stainless steels. The Babcock & Wilcox Tube Co.

OTHER EQUIPMENT

140 Chart on Heating Costs—This handy 8-pp pocket-size chart provides a yardstick for quickly determining comparative costs of chief fuels used for heating buildings in the northeastern United States. It was compiled from figures from an impartial study conducted by an independent authority and takes into account common differential factors; it is applicable wherever automatic heating equipment is used. Anthracite Institute.

141 Accelerated Cavitation Research—Twenty-pp Bulletin 02B7581 describes cavitation-pitting tests conducted to solve some of the phenomena of cavitation and to determine relative resistance to pitting of recently developed materials and techniques for applying these materials. Contents of bulletins are based on a paper by William J. Rheingans, published in a recent issue of ASME Transactions. Allis-Chalmers Mfg. Co.

142 Engineering Data on Coal Crushers—Catalog 784-A is a 40-pp guide to the selection of coal crushers. Covers single-roll crushers, stoker coal sizers, Flextooth, Flexroll, and rotary ring crushers, double-roll crushers, swing hammer pulverizers, reversible hammer crushers, and disintegrators. Gives dimensions and capacity data, also application and installation information. Photos of 16 installations are shown. The Jeffrey Mfg. Co.

143 Why Clean Oil—"The Facts About Clean Oil" is a 16-pp illustrated discussion of the long-run economy of clean oil. Explains how removal of contaminants as they form can save equipment and cut losses. Discusses value of clean oil in quenching operations, in hydraulic systems, for diesel lubrication, for transformers and electrical equipment, other uses. Honan-Crane Corp.

145 Protective Coatings—This 16-pp illustrated booklet covers a comprehensive family of products for fighting corrosion. Presents characteristics and application data on hot and cold applied tar base coatings, alkyd resin coatings, chlorinated rubber base coatings, vinyl and phenolic coatings. Includes a finder chart giving an at-a-glance summary of principal characteristics and uses of the various coatings described. Protective Coatings Div., Pittsburgh Coke & Chemical Co.

144 Engineering Data on Packings and Gaskets—In addition to descriptions of packings and gaskets, 100-pp Catalog P-100 contains charts showing recommendations for packing many types of equipment against a long list of services. Provides information on common causes of packing failure, advantages of lantern glands, proper installation procedure, temperature conversion and steam tables, water heads and equivalent pressures.

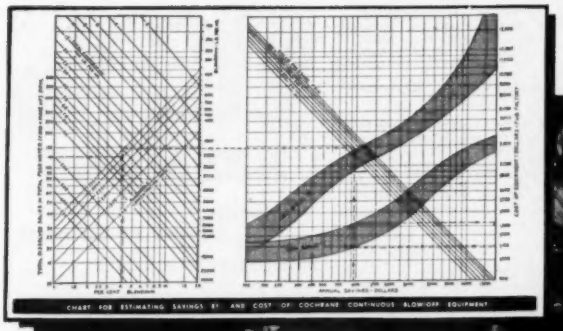
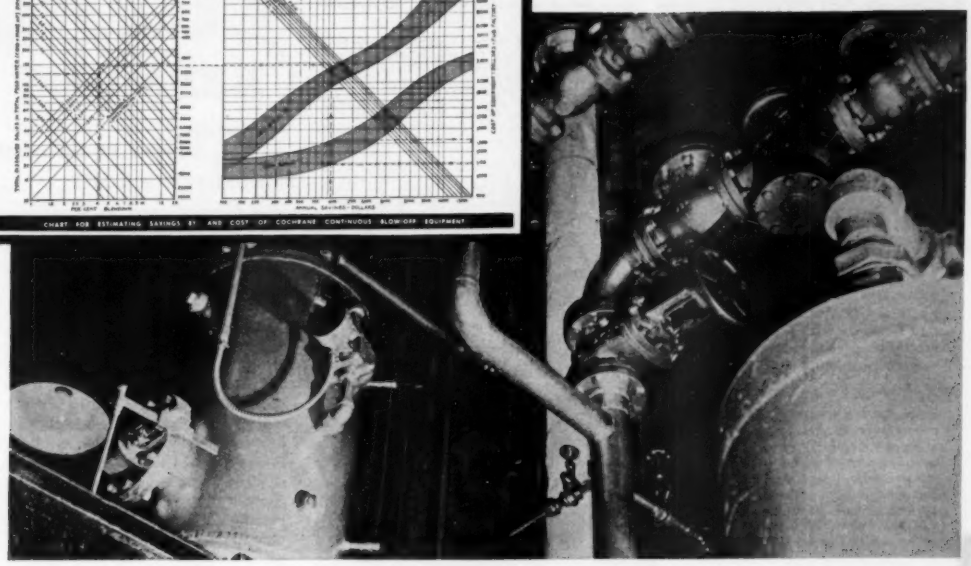


CHART FOR ESTIMATING SAVINGS BY AND COST OF COCHRANE CONTINUOUS BLOWOFF EQUIPMENT



COCHRANE CONTINUOUS BLOWOFF

If you are using old-fashioned methods of blowing down boilers intermittently, you can save heat, save fuel, save money, maintain uniform boiler concentrations—and *get your money back inside a year*—by installing a Cochrane Continuous Blowoff System.

The savings are due, first to heat recovery by utilization of steam flashed from the blowoff and by directing the hot waste water (remaining after flash) through a heat exchanger. Uniform boiler concentrations, another result, mean smoother boiling conditions, cleaner steam.

Chart shown above, for estimating savings is included in Publication 4410 a copy of which will be sent you.

SAVES HEAT
•
SAVES FUEL
•
SAVES MONEY

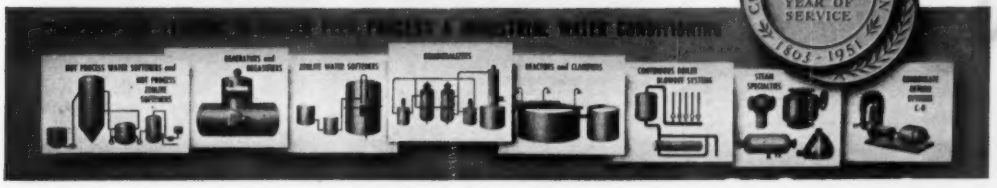
Cochrane Corporation
3123 N. 17th St., Philadelphia 32, Pa.

Please send me a copy of your Publication 4410, containing chart for figuring savings by Continuous Blowoff.

Name .....
Firm .....
Address .....
City ..... Zone ... State .....

COCHRANE CORPORATION 3123 N. 17th St., Phila. 32, Pa.
In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City • In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE



How to reduce OIL CONTENT below

1/10 part per 1,000,000

. . . in condensate and process waters

Are you discarding oil-contaminated water . . . or re-using it without adequate purification? If so, you may find filtration with Sorbo-Cel a relatively simple, inexpensive solution to your problem.

Easy, low-cost clarification . . .

Sorbo-Cel is a specially processed diatomite powder. Used in conjunction with any standard screen-type filter unit, it provides a fast, easy and inexpensive way to absorb emulsified oil and other impurities from water. Total processing costs (including both material and operation) are only from 1¢ to 3¢ *per 1000 gallons.*

How Sorbo-Cel works . . .

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through the filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through. Oil removal is virtually complete—less than 0.1 ppm remaining.

Other important advantages . . .

In addition to trapping out oil globules, Sorbo-Cel filtration removes suspended solids such as rust, scale, and clay. Boiler-tube life is increased, scale formation is reduced, and shutdowns are less frequent. In plants using graphite or wet-steam lubrication to keep condensate oil-free, this method permits a return to the more efficient oil lubrication—with resultant economies in ring wear.

For further information about Sorbo-Cel filtration, use the coupon below.

JM

Johns-Manville SORBO-CEL®

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name _____

Company _____

Address _____

City _____ State _____

PE-4

Products made of Teflon, available as gaskets, rings and irregular shapes, sheets, tubes, rods, tape, braided and plastic packings and packings for stuffing boxes and valve stems are presented. Generously illustrated, book is in loose-leaf style, and has a leatherette cover. Raybestos-Manhattan, Inc.

146 Filter for Dirty Liquids—A new hydraulic filter for use wherever dirty liquids are collected and re-circulated, and recommended for use on many hydraulically operated machines, is presented in Bulletin HF-2. Specifications are given. Cutaway drawing shows how filter is designed to provide maximum filtering area in minimum space. Dollinger Corp.

147 Hardware Handbook—Catalog 150 is a revised and enlarged book, 44 pp, combining engineering information with ordering and application data on wire rope and chain fittings. In addition to presenting detailed working characteristics of each product to remove guesswork in selecting proper fitting, includes tables and charts to make it a valuable reference book. The Thomas Laughlin Co.

148 Film Type Heat Exchangers—Bulletin HE-7 offers 6 pp of information on film type heat exchangers, explaining design principle. Installations described include power plants, chemical plants and a compression plant at an oil refinery. Henry Vogt Machine Co.

149 Blowers and Accessories—Engineering and dimensional information on low, medium and high capacity blowers is given in this recently released 6-pp bulletin. Pictures some installations, also accessories for use with the blowers. Blower Div., Standard Corp.

150 Tank Cleaning, the Safe Way—"Tank Talk" is a 50-pp pocket-size booklet written to stimulate safety among those who enter and clean gasoline storage tanks. Stresses safe procedures, particularly for removal and disposal of sludge. Its cartoon treatment tells a picture story which is amplified by a text, usually in the form of easily-remembered jingles. Petroleum Chemicals Div., E. I. du Pont de Nemours & Co., Inc.

151 Modern Panelboards—Bulletin 143, 4 pp, is a pictorial presentation of company's standard instrument mounting panels, console cabinets, cubicles for housing instruments and controls. Shows design innovations. Falstrom Co.

CATALOG LIBRARY

(Continued from page 58)

248 Handbook on Fittings and Flanges—Catalog wf-1950, 88 pp, is packed with working information on seamless carbon steel welding fittings and forged steel flanges. In addition to presenting standard schedules with their specifications, list prices and sizes, book gives information on dimensional tolerances; American standard flange facings with dimensions; thread standards and threading practice; service pressure ratings, physical and chemical requirements for flanges, nuts and bolts; plus sizes and wall thicknesses of welding fittings in other metals. Grinnell Co., Inc.

249 How to Choose and Use Air Traps—Bulletin 202, 4 pp, describes a line of air traps, covering their selection and installation for automatic drainage of moisture from compressed air intercoolers, aftercoolers, receivers, separators, drip points. Prices included. Armstrong Machine Works.

250 Safety Valve Engineering Data—How company's safety valve works and its important operating advantages are explained in Bulletin 707, 4 pp. Includes dimensions on flanged and welded inlet valve types, tables on superheat correction factor, capacities in pounds of saturated steam per hour. Manning, Maxwell & Moore, Inc.

251 Flanges for Severe Service — This 4-pp bulletin describes and illustrates a flange specially developed for services involving severe abrasion and corrosives, and for use in suction and discharge service. Also covers a flexible rubber pipe for abrasive or corrosive material, and an acid- and corrosion-resistant duct. Goodall Rubber Co.

flax

PACKINGS BY

BELMONT

Lower Equipment Maintenance Costs

Next time you order *FLAX* packings, make sure you get, finely engineered, carefully controlled Belmont—*the Better Quality Flax Packings* . . . all but the reels, come in the blue box with the orange colored trade mark.

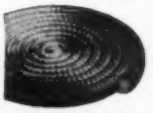
Dependable uniformity of materials, designs and constructions provide BETTER SEALING . . . LONGER PACKING LIFE. It keeps equipment on the job—producing. It enables you to *schedule* replacement—control production flow. It reduces maintenance time . . . costs.

In reels, spirals, coils and rings, you can get Belmont flax, square braided, channel style, rubber backed and a variety of constructions for all standard and special services. And, it's always uniform, because from raw materials to finished product, all Belmont Flax Packings are scientifically formulated—manufacturing operations are rigidly controlled to give you the utmost in long trouble-free, low-cost-per-year packing service.

Distributors in every large industrial center are AT YOUR SERVICE.

Where problems require technical and engineering help, write direct.

Write for catalog #40.



BELMONT 401X (Coil or Reel) — Best quality Line Flax Fibre of selected length and strength.

BELMONT 9 (Coil)— Long line best quality flax stitched with strong linen thread into a moulded rubber and duck channel.

There's a Belmont Packing for every service

4-L-2A

THE BELMONT PACKING AND RUBBER CO.
Butler & Sepviva Sts.
Philadelphia 37, Pa.

Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets
for
Steam • Water • Oil • Gas • Air
Acids • Alkalies • Ammonia

252 **To Get at those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels and makes them readily accessible. Prices given. Babbitt Steam Specialty Co.

253 **Strainers and Separators** — Bulletin R-46-50A is a 16-pp catalog on T-type strainers, suction strainers, multi-flow and receiver separators. Contains dimensions, weights, prices. Shows how several types have been redesigned for increased efficiency. Dimensions, service pressure ratings. American District Steam Co.

FUEL OILS, LUBRICANTS

254 **Fuel Oil Treatment** — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and the correction of these conditions by company's fuel oil treatment. E. F. Drew & Co., Inc.

255 **The Answers on Turbine Oil**—This 2-pp booklet answers several questions power engineers ask about turbine oils, including: What causes deposits of sludge? What causes acidity increase? What causes corrosion in turbines? Standard Oil Co. (Indiana).

256 **Grease Application Devices**—The development and use of many types of lubricating devices are discussed in an excellent article in Vol. 36, No. 9 of Lubrication, company's technical publication on lubricants. Covers the pressure gun, spring type grease cups and several types of power driven grease lubricators, explaining such points as the judicious use of pressure measured lubrication, pumpability characteristics of lubricants. The Texas Co.

257 **Air Compressor Lubrication Manual** —Valuable information on air compresor maintenance is contained in this 40-pp illustrated book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and their applications, lubrication requirements, operating hints, oil requirements, storage and care of compresor oils, and safety precautions. Cities Service Oil Co.

258 **Diesels, Their Fuels and Lubricants** —This 46-pp book offers a well organized and attractive presentation of practical information on diesel engines, covering their history and economics as well as their design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, lubricating systems, and deisel oil purification and filtration. Includes a discussion of fuel and lubricating oil required. Sinclair Refining Co.

COAL, ASH HANDLING

259 **Spreader Stoker** — Bulletin 890, 40 pp, describes a spreader stoker with overthrow rotor designed to provide uniform fuel distribution. Discusses advantages of this type of stoker, including its efficiency in the burning of many grades of coal and in handling of fluctuating loads. Power-operated and hand-operated dumping grates and stationary grates are shown. Detroit Stoker Co.

260 **Coal Handling Equipment** — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended steel bunkers. Gifford-Wood Co.

261 **Spreader Stoker Selection** — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

262 **Spreader Stoker Data**—This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

263 **Coal Scale** — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. How beam system, electrical components and linkages are protected from exposure to coal dust, explained and illustrated. Typical installations are pictured. Richardson Scale Co.

more and more Pacific

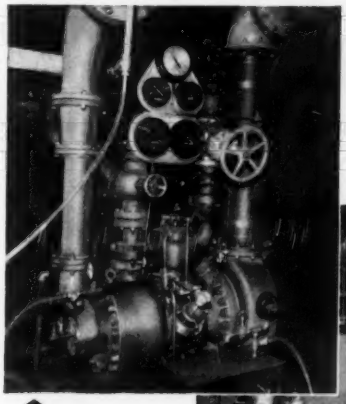
BOILER FEED PUMPS

are being built for

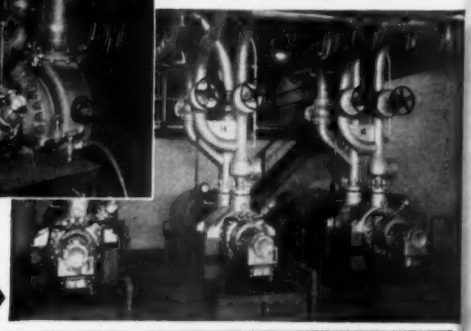
UTILITIES

INDUSTRIAL POWER PLANTS

MARINE SERVICE



Pacific Steam Turbopump



Typical Utility Boiler Feed Pump Installation

Type	Quantity	Pounds Per Hour	Degrees Temp. F.	Pounds Pressure
STEAM TURBOPUMPS	12 Pumps	31,600	250	810
ABF CENTRIFUGAL PUMPS	3 Pumps	358,120	220	1300
	4 Pumps	350,000	300	1060
	4 Pumps	455,000	336	1225
IBF CENTRIFUGAL PUMPS	3 Pumps	425,000	310	1825
	3 Pumps	495,000	306	1619
	6 Pumps	405,000	305	1750
	6 Pumps	405,000	305	1750
	3 Pumps	450,000	310	1825
	6 Pumps	550,000	334	2200
JBF CENTRIFUGAL PUMPS	2 Pumps	163,600	260	490
	1 Pump	117,500	250	775
	30 Pumps	95,000	250	810

PACIFIC Precision Built PUMPS

BF-10

Offices and Service in All Principal Cities

Pacific Pumps inc.

ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York

7 ADVANTAGES of the Duplex Strainer

1. Full control obtained by 2½ turns of single handwheel. Operates rapidly and easily.

2. TWO large identical basket strainers, either of which can be removed for cleaning without interruption to the flow.

3. Rotary valve motion eliminates dirty or clogged seats as the discs are always in contact with the seats.

4. Operating mechanism is on the downstream side of the strainer, not in the path of flow and in contact with clean strained liquid only.

5. Designed for minimum pressure drop and low maintenance (only one stuffing box).

6. Used on house service lines in major generating stations and on fuel oil lines in utility and heavy industrial plants.

7. Available in various metals and alloys for nearly all liquids. 4-inch to 24-inch pipe sizes.

•

District offices are listed in telephone directories as "R-S Products Corp'n Valves" or write direct.

•

R-S PRODUCTS CORPORATION
4600 Germantown Avenue
Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

264 **Efficient Coal Preparation**—Facts and features concerning improved coal preparation for power plants are presented in this 8-pp illustrated booklet. Shows how coal is split, not crushed, by rolling ring principle utilized in company's equipment to provide better combustion and reduced ashpit loss through uniform low-cost coal sizing. Tables show relation of sizing of coal to ashpit loss. American Pulverizer Co.

265 **Ash Handling Systems**—This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions and diagrams of arrangements included. Beaumont Birch Co.

CONDENSERS

266 **Steam Condensers with Reserve Flow**—Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning down time and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

267 **Ejector Instruction Manual**—Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water, raw water cooling, recirculation and removal of condensate. Fully illustrated. Foster Wheeler Corp.

268 **Steam Condensers**—Bulletin 102, 24 pp, is a comprehensive presentation of manufacturer's steam condensers and includes photos of six typical installations as well as a section of engineering data, a discussion of air removal equipment, and a chapter on condenser maintenance. Such special equipment as company's Wizard injector to seal small leaks while condenser is in operation, air erosion eliminators, divers lights and port gages, plugs, shock testing apparatus are also described and illustrated. Condenser Service & Engineering Co., Inc.

PUMPS AND COMPRESSORS

269 **Compressor Selection Chart**—Here's a chart, based on normal applications handling air with atmospheric intake pressure. It simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute and shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

270 **Boiler Feed Pumps**—Bulletin 109, 16 pp, illustrated in color, describes in detail centrifugal pumps for boiler feed service. Explains and pictures construction and major parts, explaining in detail the floating seal incorporated. Capacity data is provided, also vapor pressure tables. Pacific Pumps, Inc.

271 **Pulsation-Free Compressor Piping**—Illustrated Bulletin PDS-8501, 4 pp, describes company's pulsation dampening piping system. Tells how this piping compares in first cost to other piping, but affords higher operating efficiency, other advantages. Explains pulsation phenomena in gas compression systems and how dampening principle is applied. The Fluor Corp., Ltd.

272 **Data on Pumps—All Types**—Bulletins are available on centrifugal, reciprocating, screw and rotary pumps covering a wide range of capacities and services. Includes information on single and multi-stage, close coupled, single and duplex piston, and special pumps for handling erosive and corrosive liquids, also high viscosity liquids, both lubricating, non-lubricating. Warren Steam Pump Co., Inc.

HEATERS, HEATING

273 **Water Heaters**—Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-pass, four-pass and six-pass designs, with tube bundles removable for inspection. Davis Engineering Corp.

SEND FOR THIS FREE BOOK

tells how to control corrosion and scale for peak power plant efficiency... at low cost

You'll find many uses for this handy, 96 page, combination reference book and catalog. It is packed with facts on the theory and application of colorimetric methods for control of pH, Chlorine, Phosphate, Nitrate, Sulfite, Calcium, Magnesium, Silica, etc. and for determination of Water Hardness.

Specific applications to 34 basic industries are discussed.

LISTS TAYLOR COMPARATORS

Every Taylor Comparator is illustrated and described in detail. General instructions for proper use are given.

Only Taylor gives you an unlimited guarantee against fading of color standards.

WRITE FOR YOUR COPY TODAY

W. A. TAYLOR AND CO.
410 ROGERS RIDGE RD. • BALTIMORE 4, MD.

274 **Heat Exchangers** — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Cutaway drawing shows how exchanger operates, installation photos show some applications. Niagara Blower Co.

FANS, BLOWERS

275 **Mechanical Draft Fans**—An extensive line of mechanical draft fans for both forced and induced draft service is described in 20-pp Bulletin 165. Illustrated with drawings of typical fan types and photos of installations, also includes performance curves showing efficiencies of various types of fans. Gives details of construction features, drive arrangements, mounting methods. The Green Fuel Economizer Co., Inc.

276 **Axial Flow Blowers**—In this 6-pp illustrated bulletin are described axial flow blowers of both turbine-driven and motor-driven types. Gives capacity and dimensional data, operating range and specifications on both types. Also describes draft inducers. L. J. Wing Mfg. Co.

DUST CONTROL

277 **The Efficiency of Decantation**—The decantation principle as applied in dust control systems and how it separates high carbon content particles from fly ash for re-injection as fuel is discussed in illustrated Catalog 260D. A typical installation is diagrammed and efficiency curves included. Long run economy and other advantages listed. The Thermix Corp., Prat-Daniel Corp.

278 **Fly Ash Elimination** — Power engineers will find this 30-pp booklet outstanding among material on this subject. It presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash—not as a panacea for all cinder and fly ash problems. Also gives excellent engineering data on single and double hopper installations. Western Precipitation Corp.

279 **Dust Collecting Efficiency**—How the higher and narrower inlet utilized in company's tubular dust collector contributes to more efficient dust collecting is explained in this illustrated bulletin. Prat-Daniel Corp.

PACKINGS

280 **Pump Packings** — Packings for use on reciprocating and centrifugal pumps are illustrated by photo and described in this 4-pp folder. It covers packings for practically all services and includes recommendations. Johns-Manville.

281 **Teflon Packings**—Form AD143 offers 8 pp of information on packings and gasketing material made of Teflon, giving properties, typical and special applications. Styles and types are pictured, construction described, sizes given. Includes chapter on toxicology of Teflon at extremely high temperatures. The Garlock Packing Co.

282 **Manual on Packings**—Containing 84 pp of helpful engineering and ordering information, Catalog 40 covers packings for practically every service. Illustrates each type, gives sizes, construction and application details. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co.

COOLING

283 **Industrial Dry Coolers** — Illustrated Bulletin DC-50, 12 pp, presents company's line of dry cooling equipment for small, "in-between" and heavy-duty cooling jobs and includes three new models. Two of these are small "portable" units and the third a medium-size unit. Although designed primarily for cooling engine jacket water, they can also be used for cooling natural gas, lube oil, fluids of refining stages. Includes dimensions and weights, also rating tables for cooling water. The Marley Co., Inc.

TYPE 1 TYPE 1A

Single or double fan installations with automatic controls. Double operates on single furnace, or serves two. On single furnace either fan can operate up to 70 percent capacity; other fan then cuts in automatically.

TYPE 2

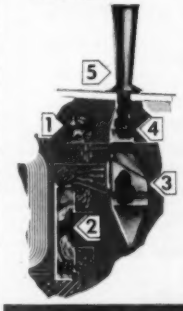
TYPE 2A

TYPE 3

You eliminate fluctuations or losses in draft efficiency by the use of Prat-Daniel Stacks. P-D Fan Stacks coordinate the relationship of fans, breeching and stacks to provide and maintain maximum efficiency.

Thousands of P-D Fan Stacks in long operation have proved their superior reliability over induced-draft fans and stacks purchased separately. Easily applied to any installation, they provide highly efficient draft for the load conditions of your power plant.

Our project engineers provide expert assistance on any problems of draft production and control. Call them on current problems or planned installations. Write for Catalog No. 200.



UNIT RESPONSIBILITY

Prat-Daniel, through its sales and project engineers, The Thermix Corp., offer a complete complement for handling the air gas stream shown at left; 1. Forced Draft Fans, 2. Air Pre-heaters, 3. Tubular Dust Collectors, 4. Induced Draft Fans and 5. Fan Stacks. This unit responsibility, by a well-known firm, relieves the engineer of the responsibility for one of the most important functions in a steam generating plant.

Sales and Project Engineers

THE THERMIX CORPORATION
GREENWICH, CONN.

Canadian Affiliates: T. C. CHOWN, LTD.
1440 St. Catherine St., W., Montreal 25, Quebec
50 Abell St., Toronto 3, Ontario

Designers and Manufacturers

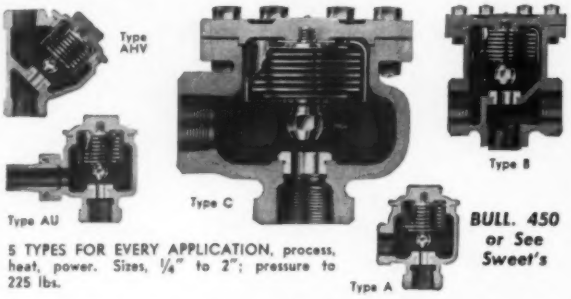
PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.

In This Plant Nicholson Traps

SAVED 10% IN STEAM COSTS

Chief Engineer H. F. D. stated, after Nicholsons replaced mechanical traps in his plant: "Saving in steam waste cut our fuel cost at least 10%. Yet application temperatures were up 30°-40°. And relief of all air binding effected faster warm-up."

Operate on lowest temperature differential; 2 to 6 times average drainage capacity; maximum air venting. For other advanced Nicholson features send for Bulletin 450.



5 TYPES FOR EVERY APPLICATION, process, heat, power. Sizes, ¼" to 2"; pressure to 225 lbs.

BULL. 450 or See Sweet's

W. H. NICHOLSON & CO., 160 Oregon St., Wilkes-Barre, Pa.

Sales and Engineering Offices in 53 Principal Cities

Consult Us For:

CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS

AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES:
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • PITTSBURGH • CHARLOTTE

The
MAINTENANCE DEPARTMENT
of
CONDENSER SERVICE & ENGINEERING CO., INC.
100 RIVER ST., HOBOKEN, N. J.

Offers to do

QUICK—PROMPT

RETUBING SERVICE

on BOILERS — CONDENSERS HEAT EXCHANGERS

ANYTHING WITH TUBES

24 HOURS A DAY — 7 DAYS A WEEK
365 DAYS A YEAR

SATURDAYS - SUNDAYS HOLIDAYS

WE CARRY TUBES IN STOCK

CALL — TELEPHONE: Day and Night
NEW YORK: REctor 2-9363
HOBOKEN: HOboken 3-4428

St. Paul, Minn.:
Day—Nestor 9675 - Night—Emerson 3219
Chicago, Ill.:
Day—STate 2-1415 - Night—SHeldrake 3-4735
Boston Mass.:
Day—LAfayette 3-1091 - Night—MYstic 6-4552
Tulsa, Okla.:
Day—Tulsa 5-7717 - Night—Tulsa 4-4060
Phila, Pa.: Day—Wilmington (Del.) 7151
Night—Chester (Pa.) 2-4576
Baltimore, Md.: SAratoga 5285
Atlanta, Ga. Dearborn 4477
Washington, D. C.: Republic 4875
Los Angeles, Cal.: TRinity 7861

284 **Cooler with Fins**—A new oil and water cooler and the several advantages provided by its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, distinguished by use of helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact and less costly unit for a given cooling service. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. Also described are design details which provide effective heat transfer, permit free expansion of tube bundle, prevent leakage and facilitate maintenance. The Griscom-Russell Co.

OTHER EQUIPMENT

285 **The ABC of CO_2**—An interesting, readable text covering the role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Includes scales of total heat losses of various types of coal, fuel oils and gas, also case histories of savings realized through increased CO_2 percentage. The Hays Corp.

286 **Cleaning Industrial Equipment**—This bulletin on manufacturer's service for cleaning steam generating, heat exchange and other industrial equipment includes information on pipe line cleaning and water well acidizing. Treats in detail methods used to remove incrustations from internal surfaces economically with minimum of downtime. Dowell Inc.

287 **Fundamentals of Hydraulics**—Technical Bulletin B-4 is a newly revised 44-pp guidebook covering essential information on hydraulic systems, maintenance trouble-shooting and selection of proper fluids. Besides offering well-organized reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators and apprentices. It features specially prepared phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Shows function of each component part. Sun Oil Co.

288 **Transmission Belting** — Catalog M-9922, 28 pp, gives detailed design, engineering and performance data on transmission belting. Tables on belt speeds, arc of contact, friction, horsepower correction, and service factors are included. United States Rubber Co.

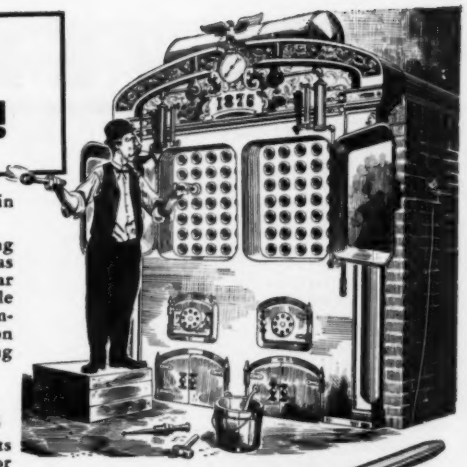
289 **Turbine Catalog Collection**—This is a valuable collection of bulletins covering a complete description of solid wheel turbines. They feature cross section drawings of typical units for both moderate and high steam pressure conditions. Includes data on speed increasing and reduction gears. The Terry Steam Turbine Co.

290 **Steels for Hot Spots** — This is an 88-pp manual filled with information on steels for elevated temperature service. Includes a discussion of the general principles of high temperature behavior of ferrous materials and the factors influencing their behavior; a data section replete with tabular and graphical material covering mechanical property values of 21 steels. United States Steel.

291 **Paints to Beat Corrosion**—This 8-pp illustrated bulletin is devoted to company's line of anti-corrosive paints. Discusses their sub-oxide of lead base and other technical properties and points out savings in time and money afforded by the use of these rust-inhibitive coatings. Describes primers, finishing coats and single coats available; tells how to apply them. Also discusses painting of galvanized structures. Subox, Inc.

292 **Power Plant Communication Systems** — This 25-pp brochure describes a high and low level intercom system designed and built especially for power plants — a system readily installed and permitting two-way conversations over close-speaking microphones and receivers (they look like ordinary telephone handsets) as well as paging over loudspeakers suited to different noise levels. Booklet tells what the system can do for your plant and includes photos of the equipment used. Also provides many views of a modern generating station in which this equipment is installed, showing its location in the central control room, turbine room, boiler firing aisle, and other places. Gai-Tronics Corp.

Egbert Had Only One Tube Expander!



When boilers wore bustles, Egbert had his troubles. Leaking boiler tubes lost water and steam, so he had a constant battle to keep tubes tight. With rolled-up sleeves and a frown on his face, Egbert hammered the mandrel and turned it with a pin... hammered and turned until he was as beaten and battered as the mandrels.

Today Egbert smiles as he uses a quick-acting, self-feeding Wilson Tube Expander. A simple ratchet wrench or power-driven machine does the job. Wilson rolls and mandrels are ground to assure precision expansion, smooth wrinkle-free performance and perfectly set tubes. Generous radii on front of rolls prevent sharp shoulders. Compact designs permit use in limited space.

Many types and sizes of flaring and non-flaring expanders, as well as ratchet wrenches, gear drives and electrical reversible tube rollers, are available immediately from large Wilson stock. Write for Catalog, giving details on complete line.

FAST-ACTING WILSON TUBE CLEANERS

For rapid tube cleaning, units driven by water, air, steam or electricity are available. As hundreds of satisfied users know, these sturdy tube cleaners reduce down-time... lower maintenance costs.

Write for Bulletin 47-A

TW 700

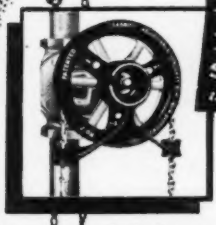
WILSON

THOMAS C. WILSON, INC., 21-11 44th AVE., LONG ISLAND CITY 1, N. Y.
Cable "Tubeclean" New York • Representatives in All Principal Cities

WILSON TUBE CLEANERS • WILSON TUBE EXPANDERS

POSITIVE! EFFICIENT! SAFER!

VALVE CONTROL AT LOWEST COST!



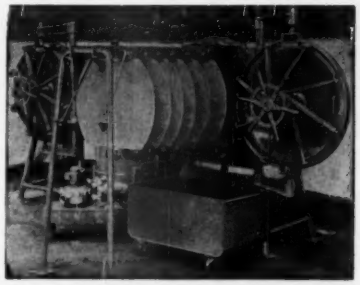
Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

INSTALLED, AND OPERATING, IN ONLY A FEW MINUTES

- Here's easy, convenient, instant control of overhead, out-of-reach valves—right from the floor! No expensive apparatus! No switches! Nothing to break down when most needed! BABBITT Adjustable Sprocket Rim with Chain Guide, with only four simple parts, gives you positive efficient valve control at lowest cost!
- Prevents accidents, prevents waste, provides efficient control, and saves money. A range of 10 ADJUSTABLE sizes fits all valve wheels, with rising or non-rising stems, from 2 to 30 inches in diameter.

Distributors in Principal Cities, or send for Catalog Folder PE-2 and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square
NEW BEDFORD, MASSACHUSETTS



EMULSIFIED OR FREE OILS

Effectively Removed from Condensate with the

BLACKBURN-SMITH REFINER

OUTSTANDING ADVANTAGES

1. Breaks the tightest emulsion of oil in water
2. Reduces contamination to less than .1ppm.
3. Produces pure, clean condensate 4. Saves boiler tubes

Contaminated Condensate Formerly Wasted Can Now Be Re-Used After Filtration Through the Refiner

Proved in service . . . saves heat units and fresh water . . . no backwashing . . . reduces boiler maintenance costs . . . improves boiler efficiency . . . simple and inexpensive to operate . . . requires little space.

Write for catalog. Engineering assistance gladly furnished.

THE BLACKBURN-SMITH MFG. CO., INC.

98 RIVER STREET, HOBOKEN, NEW JERSEY

Subsidiary of Condenser Service & Engr. Co., Inc.

HOBOKEN 3-4425 RECTOR 2-9360

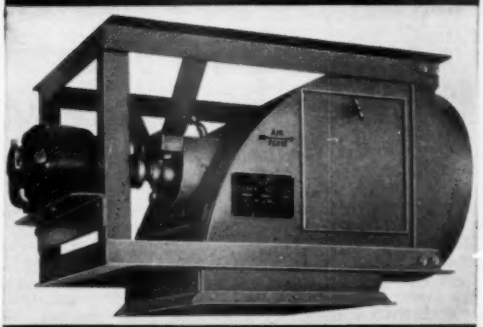
ADVERTISERS

Air Preheater Corp., The 129
Agency—G. M. Basford Company
Allis-Chalmers Mfg. Co. 12-13, 23, 123
Agency—Compton Advertising, Inc.
American Chimney Corp. 138
American District Steam Company, Inc. 120
Agency—Squier and Davis, Inc.
American Engineering Co. 127
Agency—Beatty and Oliver, Inc.
American Pulverizer Co. 131
Agency—Batz, Hodgson, Neuwoehner Advertising Agency
American Water Softener Co., The 125
Agency—Harris D. McKinney Organization
Armstrong Machine Works 4
Agency—Russell T. Gray, Inc.
Atlas Valve Co. ..... *
Agency—W. F. Schaphorst
Babbitt Steam Specialty Co. 139
Agency—Paul L. Kuch Advertising
Babcock & Wilcox Co., The 31
Agency—O. S. Tyson and Company, Inc.
Bailey Meter Company 36
Agency—Fuller & Smith & Ross, Inc.
Baldwin-Hill Co. 56
Agency—O. S. Tyson and Co., Inc.
Beaumont Birch Company 132
Agency—The Harris D. McKinney Organization
Belmont Packing & Rubber Co., The 134
Agency—McNevin-Wilson-Dalldorf, Inc.
Betz, W. H. & L. D. 101
Agency—The Harris D. McKinney Organization
Biddle Co., James G. ..... *
Agency—The Roland G. E. Ullman Organization, Inc.
Bird-Archer Co., The ..... *
Agency—Michel-Cather, Inc.
Blackburn-Smith Mfg. Co., Inc., The 139
Black, Sivalls & Bryson, Inc. 111
Agency—The Potts-Turnbull Company
Bowser, Inc. 42
Agency—Willis S. Martin Company
Builders-Providence, Inc. 128
Agency—Hammond-Goff Co.
Cambridge Instrument Co., The ..... *
Agency—E. M. Freystadt Associates, Inc.
Chapman Valve Mfg. Co., The ..... Inside Back Cover
Agency—Sutherland-Abbott
Cities Service Oil Co. 51
Agency—Ellington & Company, Inc.
Cleaver-Brooks Company ..... *
Agency—Klau-Van Pieterson-Dunlap Associates, Inc.
Cochrane Corporation 133
Agency—Willard G. Myers Advertising Agency
Combustion Engineering-Superheater, Inc. 48-49
Agency—G. M. Basford Company
Condenser Service & Engineering Co., Inc. 138
Crane Co. 53
Agency—The Buchen Company
Crane Packing Co. 126
Agency—Symonds, MacKenzie & Co., Inc.
Dart Union Co. 110
Agency—Sutherland-Abbott
Davis Engineering Corporation ..... *
Agency—Thomas & Delehanty, Inc.
Davis Regulator Co. ..... *
Agency—Armstrong Advertising Agency
Dearborn Chemical Company 59
Agency—The Buchen Company
De Laval Separator Co., The 107
Agency—Donahue & Coe, Inc.
Detroit Stoker Company 16-17
Agency—Witte & Burden
Dowell Incorporated 47
Agency—MacManus, John & Adams, Inc.
Drew & Co., Inc., E. F. 33
Agency—The Aitkin-Kynett Co.
Eastern Gas and Fuel Associates 121
Agency—Ketchum, MacLeod & Grove, Inc.
Edward Valves, Inc. ..... *
Agency—Marsteller, Gebhardt & Reed, Inc.
Elliott Co. 2-3
Agency—Peterson & Kempner, Inc.
Ellison Draft Gage Co. ..... *
Agency—Tri-State Advertising Co., Inc.
Engineer Co., The 18
Agency—Michel-Cather, Inc.
Erie City Iron Works ..... *
Agency—Davis and McKinney
Everlasting Valve Co. 118
Agency—Michel-Cather, Inc.
Flexitallic Gasket Company 55
Agency—William Jenkins Advertising
Fluor Corporation, Ltd. ..... *
Agency—Dozier, Eastman & Co.
Foster Engineering Company 124
Agency—Sanger-Funnell, Incorporated
Foster Wheeler Corp. ..... *
Agency—Albert Frank-Guenther Law, Inc.
Garlock Packing Co., The ..... *
Agency—Hutchins Advertising Company, Inc.
General Coal Company ..... *
Agency—The Aitkin-Kynett Co.
General Electric Company 32
Agency—G. M. Basford Company
Gifford-Wood Co. ..... *
Agency—O. S. Tyson and Company, Inc.
Gilbert Associates, Inc. 113
Agency—The Richard A. Foley Adv. Agency, Inc.
Goodall Rubber Co., Inc. 130
Agency—George C. Taylor
Graver Water Conditioning Co. 50
Agency—Michel-Cather, Inc.
Green Fuel Economizer Co., Inc. 112
Agency—Sanger-Funnell, Incorporated
Grinnell Co., Inc. 115
Agency—Horton-Noyes Company
Griscom-Russell Co., The 28
Agency—Michel-Cather, Inc.
Hagan Corporation ..... *
Agency—Ketchum, MacLeod & Grove, Inc.
Hall Laboratories, Inc. 109
Agency—Ketchum, MacLeod & Grove, Inc.
Hays Corporation, The 14-15
Agency—Proebsting, Taylor, Inc.
Infilco Incorporated 105
Agency—The Vanden Company, Inc.
International Nickel Company, Inc., The ..... *
Agency—Marschalk & Pratt Co.
Johns-Manville 134
Agency—J. Walter Thompson Company
Kuljian Corporation, The ..... *
Agency—Al Paul Lefton Company, Inc.
Ladish Co. 19
Agency—The Cramer-Krasselt Co.
Manning, Maxwell & Moore, Inc. 103
Agency—Fuller & Smith & Ross, Inc.
Marley Company, Inc., The 41
Agency—Valentine-Radford Advertising
Mundet Cork Corporation ..... *
Agency—J. C. Bull Incorporated
National Airoil Burner Company, Inc. ..... *
Agency—R. E. Lovekin Corp.
National Aluminate Corporation 44
Agency—Armstrong Advertising Agency
National Valve & Mfg. Co. ..... *
Niagara Blower Company ..... *
Agency—The Moss-Chase Company
Nicholson & Co., W. H. 138
Agency—Wilbur A. Myers
Northern Equipment Company 61
Agency—Davies and McKinney
Pacific Pumps, Inc. 135
Agency—The McCarty Company
Permutit Co., The ..... *
Agency—Cunningham & Walsh, Inc.

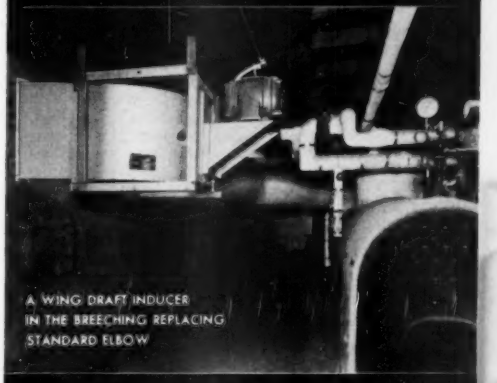
Prat-Daniel Corp. 137
Agency—Hening & Company, Inc.
% Proportioneers, Inc. % 117
Agency—Hammond-Goff Co.
Raybestos—Manhattan, Inc. 20
Agency—Gray & Rogers
Republic Flow Meters Co. ..... *
Agency—Glenn, Jordan, Stoetzel, Inc.
Richardson Scale Co. 106
Agency—O. S. Tyson and Company, Inc.
Riley Stoker Corporation ..... *
Agency—The Davis Press, Inc.
Rockwell Mfg. Co. ..... *
Agency—Marsteller, Gebhardt & Reed, Inc.
Rohm & Haas Company ..... *
Agency—John Falkner Arndt & Company, Inc.
Roto Div. of Elliott Co. 116
Agency—Jos. S. Vogel & Co.
R-P & C Valve Division, American Chain & Cable 108
Agency—Reincke, Meyer & Finn
R-S Products Corporation 26, 136
Agency—Carl M. Craig Agency
Sarco Company, Inc. ..... *
Agency—Gus Binz Associates
Shell Oil Company 34-35
Agency—J. Walter Thompson Company
Simplex Valve & Meter Co., The ..... *
Agency—Cunningham & Walsh, Inc.
Sinclair Refining Co. 38-39
Agency—Morey, Humm & Johnstone, Inc.
Southern Coal Company, Inc. ..... *
Agency—Robertson & Buckley, Inc.
Standard Oil Co. (Indiana) 29
Agency—McCann-Erickson, Inc.
Stone & Webster Engineering Corporation 24
Agency—Harold Cabot & Co., Inc.
Subox, Inc. ..... *
Agency—Kirk B. Shivell, Inc.
Sun Oil Company 57
Agency—Gray & Rogers
Swartwout Company, The 6
Agency—Palm & Patterson
Taylor & Co., W. A. 136
Agency—Emery Advertising Corporation
Terry Steam Turbine Co., The 40
Agency—Michel-Cather, Inc.
Texas Co., The ..... Back Cover
Agency—Erwin, Wasey & Company, Inc.
Thermix Corp., The 137
Agency—Hening & Company, Inc.
Treasury Department ..... *
United States Rubber Company ..... *
Agency—Fletcher D. Richards, Inc.
United States Steel Corp. ..... *
Agency—Batten, Barton, Durstine & Osborne, Inc.
Universal Atlas Cement Co. (Lummite Division) ..... *
Agency—Batten, Barton, Durstine & Osborne, Inc.
Vogt Machine Co., Henry 21
Agency—Farson & Huff
Vulcan Soot Blower Division, Continental Foundry & Machine Company ..... *
Agency—Davies and McKinney
Wallace & Tiernan Products, Inc. 122
Agency—Branstater-Hammond
Warren Steam Pump Co., Inc. 25
Agency—The Davis Press, Inc.
Western Chemical Company 114
Agency—Carter Advertising Agency, Inc.
Western Precipitation Corp. ..... *
Agency—Dozier, Eastman & Co.
Westinghouse Electric Corporation 43, 119
Agency—Fuller & Smith & Ross, Inc.
Wheeler Mfg. Co., C. H. 22
Agency—The Roland G. E. Ullman Organization, Inc.
Wickes Boiler Co., The 37
Agency—Price, Hedrick & Tanner, Inc.
Wilson, Inc., Thomas C. 139
Agency—Michel-Cather, Inc.
Wing Mfg. Co., L. J. 141
Agency—Willard G. Myers Advertising Agency
Worthington Pump & Machinery Corp. 9, 27, 30
Agency—James Thomas Chirurg Company
Yarnall-Waring Company 10-11, 62
Agency—Michener & Holland

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *

THIS IS THE WING DRAFT INDUCER



THIS IS A TYPICAL INSTALLATION



A WING DRAFT INDUCER IN THE BREECHING REPLACING STANDARD ELBOW

THIS IS WHAT IT WILL DO

1. **Eliminate tall, unsightly and expensive stacks. All that is left is a vent on the discharge.**
2. **Cut fuel costs. Give higher CO_2's. Less excess air.**
3. **No smoke.**
4. **Permit increased capacities.**

THIS COUPON WILL BRING FULL DETAILS

L. J. Wing Mfg. Co.
64 Vreeland Mills Road
Linden, New Jersey

Please send literature and complete information on the Wing Draft Inducer.

Name.....

Firm.....

Address.....

City..... Zone..... State.....

PRESSURIZED BOILER

(Continued from page 83)

tial that would cause an expansion between tubes and casing of about 3 in. on a unit 100 ft high. This would introduce casing leakage and air infiltration.

One remedy proposed was to weld all wall tubes together. This, however, would introduce locked up stresses in field erection which would be very difficult to remove.

A practical alternative was to follow the practice in Naval and locomotive forced circulation units. By placing the casing immediately against the back of the tubes and then applying the insulation outside the casing, the casing itself is kept at saturation temperature and there is no great differential to cause expansion between casing and tubes, according to Mackenzie. During starting up, tube temperature increases a little faster than that of the casing and there would be a small expansion to be taken care of. However, note on Fig. 6, Section CC, that the casing panel is built with a flange that is not at right angles, and the toes of the plate and channel flanges are welded together. This provides for possibility of expansion from as much as 150 F temperature differential between plates and tubes. Actually it has never been measured at more than 60 F. The entire casing is designed to withstand internal pressure of 150 lb per sq ft.

Casing Erection and Testing

Mackenzie states that an additional two weeks should be allowed in erection time on a large utility unit to make certain the casing is absolutely tight before the insulation is applied. This is done by putting a pressure test on the unit, using compressed air and going over all joints with soapy water. Then all leaks can be welded.

With 25 or 30 in. H_2O air pressure in the setting, the furnace can be temporarily sealed and permissible pressure drop measured; a standard of not more than 2 in. in 10 min has been set up. At Knox Lee the actual drop was 2 in. in 26 minutes.

Openings in Casing

Inspection and access doors must be gasketed and made tight. The ash hopper on a coal-fired job must receive special treatment; and, on coal- and oil-fired jobs, the soot blowers where they pass through the wall, must be suitably sealed. Openings for oil burners must be closed off when the guns are removed and on pulverized coal fired units or cyclone furnace units a suitable seal must be provided to prevent blowing back through the feeder. The latter has been done successfully on the Dow Chemical Co. units by development of new types of sealing feeders.

Inspection doors must be so designed that gases will not blow out into the fire room when they are opened. They can, of course, have pyrex windows. To open them, they are usually equipped with aspirators to blow compressed air (station air at 80 psi or 100 psi) through ports provided in the door frame, thus preventing gas and fire from blowing out. A safety latch in the door is so arranged that the station air must be turned on before the door can be opened.

To design a self-sealing distance piece through which the oil burner barrel or gun is inserted is a relatively simple matter, already done on marine boilers. When the oil burner barrel is removed, a flap gate or check valve at the furnace end of the distance piece automatically closes and is held closed by the pressure in the furnace.

How Soot Blower Openings Are Handled

To provide tight seal where retractable soot blowers pass through the casing, says Mackenzie, has proved to be the most troublesome feature. Initial design of such seals, as used at Twin Branch and Philip Sporn plants, leak badly enough so that it has not been possible to operate these units under pressure for any extended period. To overcome this difficulty, two new types of seals have been designed and are currently being tried out at Twin Branch.

The retractable blower can be withdrawn entirely out of the setting and an automatically closing door provided that will close after it is retracted. This must be equipped with air aspirators just like the inspection door.

Wall blowers, standard revolving type blower units and telescopic blowers present few difficulties and are all sealed similarly. A piece of tubing from the wall blower head to the casing makes it self-sealing. A small amount of air through this tube will keep the blower element cool.

Ash Removal in Pressurized Furnaces

Removal of ash from the hoppers of a pressurized job is somewhat more of a problem than on a suction job. Care must be taken to provide for large pieces of slag that occasionally drop down into the ash pit. This does not apply to the cyclone furnace burning crushed coal, for here the molten slag drains continuously into a special sealed ash-sluicing system, especially designed for pressure operation.

However, on other types of coal-burning furnaces, the ash removal system must be a double one designed like an air lock in a caisson. For example, on a dry-bottom installation with ash hopper integral with boiler, there are hydraulically-operated slide gates between the main hopper and the secondary hopper. The latter may in turn lead to a sluicing system or a vacuum ash removal system. It also has a gate at the end or slide.

Ash from the integral hopper is dumped into the secondary hopper with the gate closed, thus putting the secondary hopper under furnace pressure. Here, too, suitable air-aspirated access doors are provided. After the primary hopper has been emptied, its gates are closed and the gate leading out of the secondary hopper is opened.

Because there has been little operating experience with ash-handling systems under pressure firing, several of the large pulverized coal and cyclone furnace jobs for pressure operation are also installing emergency induced-draft fans as insurance against the possibility of outage caused by difficulties in either ash or slag removal. However, on the oil- and gas-fired pressurized units, no induced-draft fans are installed nor contemplated.

Principal deterrent to operating under pressure for long periods has been the retractable soot blowers. In addition to difficulties in sealing them where they pass through the wall, they had trouble in one case with steam from a retractable blower coming on too soon and blowing between tubes and casing, thus separating casing from tubes. There has been a little trouble from condensate dripping from the end of a retractable blower into the insulation after the blower was shut off. This formed steam in the insulation and forced it away from the casing. Both these difficulties can be eliminated, says Mackenzie, by installation of an extension to the wall box, carrying it through the tubes.

CLASSIFIED ADVERTISING

HELP WANTED

WANTED — GRADUATE MECHANICAL ENGINEERS

For employment in Power Station design engineering with a public utility. Various openings available for men with general layout, piping and drafting experience. Location, Western Pennsylvania. Qualifications, experience record, salary desired, and picture should be submitted with letter of application. Address Box 1656, Power Engineering, 110 S. Dearborn St., Chicago 3, Ill.

POSITION WANTED

SITUATION WANTED: 21 years in supervisory capacity. 10 years Power Superintendent, high pressure boilers and turbines. Excellent references. Reply Box 1654, Power Engineering, 110 S. Dearborn St., Chicago 3, Ill.

Power Plant Engineer—8 years experience in the operation and maintenance of marine and industrial power plants. Some construction, refrigeration and technical education. Address Box 1655, Power Engineering, 110 S. Dearborn St., Chicago 3, Ill.

POSITION WANTED—Technically trained man with 10 years experience in operation and maintenance in steam turbo electric industrial power plant desires a position as supervisor in small or medium power plant. Address Box 1657, POWER ENGINEERING, 110 S. Dearborn Street, Chicago 3, Ill.

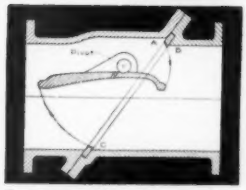
Stop Expensive Slamming With the Cushioned Closing of CHAPMAN TILTING DISC Check Valves

Those words — *cushioned closing* — best describe the action of this unique check valve. The tilting disc works with the stream—opens easily, closes quickly, *yet quietly.* There's no slamming — no resultant destructive stresses on the pipeline.

As a result of this smooth, *cushioned action*, maintenance costs are at a minimum and savings of from 65% to 80% in head losses can be obtained over conventional-type check valves.

Send today for the bulletin describing this unusual valve.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

OUT GO RUST, SLUDGE AND FOAM

When TEXACO REGAL OILS (R&O) go *IN*

To assure the full-time, full-power turbine performance that present-day production schedules demand, lubricate with *Texaco Regal Oils (R&O)*. For years before the development of rust- and oxidation-inhibiting additives, *Texaco Regal Oils* were world-famous turbine oils. Now, *with* these effective additives *plus* special foam-resistant properties, *Texaco Regal Oils (R&O)* assure better-than-ever performance.

With *Texaco Regal Oils (R&O)* in your turbines, rust, sludge and foam don't have a chance. Bearings get full protection, and governor action is sensitive and alert. *Texaco Regal Oils (R&O)* give you an extra-long oil service life . . . need less attention. Result—a greater margin of safety and lower maintenance costs.

Texaco Regal Oils (R&O) are approved by leading turbine builders and are available in every needed viscosity.

A Texaco Lubrication Engineer will gladly help you to greater efficiency and economy throughout your plant. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

REG'T M.

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TUNE IN . . . TEXACO STAR THEATER starring **MILTON BERLE** on television every Tuesday night. See newspaper for time and station.